

## 1394 Drive Conversions

### Catalog Numbers

1394-SJT05-A, 1394-SJT10-A, 1394-SJT22-A,  
1394-SJT05-C, 1394-SJT10-C, 1394-SJT22-C,  
1394-SJT05-T, 1394-SJT10-T, 1394-SJT22-T,  
1394C-SJT05-A, 1394C-SJT10-A, 1394C-SJT22-A,  
1394C-SJT05-C, 1394C-SJT10-C, 1394C-SJT22-C,  
1394C-SJT05-T, 1394C-SJT10-T, 1394C-SJT22-T,  
1394C-SJT05-D, 1394C-SJT10-D, 1394C-SJT22-D,  
1394C-SJT05-L, 1394C-SJT10-L

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## About This Publication

This publication provides a migration path for converting your 1394 multi-axis drive system to a Kinetix 6000 multi-axis drive system. Included are checklists describing the differences between the drive families and specific mounting and wiring information for determining the impact on panel space and cable lengths. Also included are drive specifications, drive/motor system performance specifications, and GML to RSLogix 5000 programming software conversion examples.

This publication does not include the conversion of 9-Series, CNC system modules (catalog numbers 1394-SJTxx-E).

### ATTENTION



While executing the migration, a risk assessment should be conducted to make sure that all task-hazard combinations have been identified and addressed. The risk assessment may require additional circuitry to reduce the risk to an acceptable level.

Additional Resources, on page 151, contains publication numbers for the Kinetix Motion Control Selection Guide, Motion Analyzer CD, and drive manuals you will need to complete your 1394 drive conversion.

## About Converting From 1394 Drives

For each 1394 control feature, you can find a suitable solution with Kinetix 6000 multi-axis servo drives, ControlLogix or CompactLogix controller platforms, and RSLogix 5000 programming software.

## Checklist for All 1394 System Conversions

This table provides a checklist of common considerations when migrating from any 1394 system module to Kinetix 6000 drives.

1394 Drive Feature/Function	Page	Kinetix 6000 Conversion	Page	✓
<b>DC Common Bus Capability</b>				
The 1394 DC Link Module (DCLM) provides additional load leveling and energy storage (capacitance) for 1394 systems. The module can be used alone or linked to a second 1394 system with the DCLM module using the DC Link cable.	N/A	You can configure the Kinetix 6000 IAM module in RSLogix 5000 software as a common-bus master or common-bus follower drive based on system needs for regeneration or configuration requirements. When planning your panel layout, the common-bus master must be configured to include the common-bus follower capacitance since it controls system precharge and shunt control.	11	
<b>Typical Input Power Components</b>				
<ul style="list-style-type: none"> <li>324...528V ac, 50/60 Hz, 3-phase input</li> <li>24V ac control power supply</li> <li>Disconnect, fuse block, main contactor</li> <li>24V dc power supply for motor brakes and motor thermal contacts</li> </ul>	37	Kinetix 6000 drives have similar requirements for input power and you may be able to reuse some of your 1394 input power components.	40	
		The Line Interface Module (LIM) includes many of the input power components that you will need for your Kinetix 6000 system and provides 3-phase input power, control power, auxiliary power, and 24V dc power for motor brakes.	44	

1394 Drive Feature/Function	Page	Kinetix 6000 Conversion	Page	✓
Customer-supplied External 24V dc Power Supply for Motor Brakes				
<ul style="list-style-type: none"><li>On GMC and analog systems, the brake connections are made on the bottom of each axis module (TB1 and TB2).</li></ul>	27	The Kinetix 6000 IAM and AM (inverter) modules also require 24V dc input for motor brakes. However, the Motor Brake (BC) connector on each IAM and AM module also provide programmable motor brake relay outputs and supply an MOV device for arc suppression.	28	
<ul style="list-style-type: none"><li>On SERCOS interface systems, the brake connections are made on the relay outputs connector on the system module.</li></ul>	30			
I/O Terminations				
<ul style="list-style-type: none"><li>GMC system modules have an input wiring board (TB1 and TB2) where the I/O for up to four axes terminate.</li></ul>	29	The Kinetix 6000 IAM and AM modules each have their own dedicated I/O (IOD) connector for terminating the individual I/O points for each axis. Each IOD connector requires a low-profile connector kit (catalog number 2090-K6CK-D26M).	32	
<ul style="list-style-type: none"><li>SERCOS interface system modules have four 8-pin connectors where the I/O for up to four axes terminate.</li></ul>	30			
Relay Outputs to Protect Drive Electronics				
<ul style="list-style-type: none"><li>On GMC system modules the Drive OK relay output is on the input wiring board (TB2).</li></ul>	29	The Kinetix 6000 IAM module provides the Contactor Enable (CED) connector for the same purpose. Wiring the contactor enable relay into your safety control string is required.	32	
<ul style="list-style-type: none"><li>On SERCOS system modules the Drive OK relay output is on the relay outputs connector.</li></ul>	30			
<ul style="list-style-type: none"><li>On Analog system modules the Contactor Enable relay output is on the input wiring board (TB2).</li></ul>	31			
Digital Input and Registration Input Power Supplies				
<ul style="list-style-type: none"><li>The GMC system modules require an external 5V dc or 24V dc supply for the registration inputs and 24V dc for digital inputs.</li></ul>	33	The Kinetix 6000 has an internal 24V dc power supply on each IAM/AM module dedicated for use by the enable, home, and overtravel digital inputs, and two registration inputs.	33	
<ul style="list-style-type: none"><li>The SERCOS system modules require an external 24V dc for the two registration inputs and 24V dc for the four digital inputs.</li></ul>	36		36	
Hardware Enable Inputs				
<ul style="list-style-type: none"><li>The GMC system modules provide only one System Enable input (TB1 or TB2).</li></ul>	33	The Kinetix 6000 IAM and AM modules each have their own Hardware Enable input on the I/O (IOD) connector. Each IOD connector requires a low-profile connector kit (catalog number 2090-K6CK-D26M).	33	
<ul style="list-style-type: none"><li>Each 8-pin I/O connector on the SERCOS interface system module has its own Hardware Enable input.</li></ul>	36		36	
Servo Motor Compatibility				
Bulletin 1326AB (resolver) servo motors	47	You can continue to use the Bulletin 1326AB or 1326AS (resolver) servo motors and the same motor power and feedback cables. However, when migrating to Kinetix 6000 drives you need the low-profile connector kit (catalog number 2090-K6CK-D15MF) for each of these motors. This kit includes noise filters for the thermal switch connections that replace the filter circuitry between TB1 and TB2 on the bottom of each 1394 (series C) axis module.	47	
Bulletin 1326AS (resolver) servo motors	48		48	
Bulletin 1326AB (M2L/S2L) servo motors	47	You can continue to use the MP-Series (Bulletin MPL) or 1326AB (M2L/S2L) servo motors. However, when migrating to Kinetix 6000 drives you need to replace the feedback cable for MPL-BxxxM/S and 1326AB (M2L/S2L) motors. You also need one low-profile connector kit (catalog number 2090-K6CK-D15M) for each of these motors.	47	
MP-Series (catalog numbers MPL-BxxxM/S) servo motors with high-resolution feedback	49		49	
MP-Series (catalog numbers MPL-BxxxR) servo motors with resolver feedback				

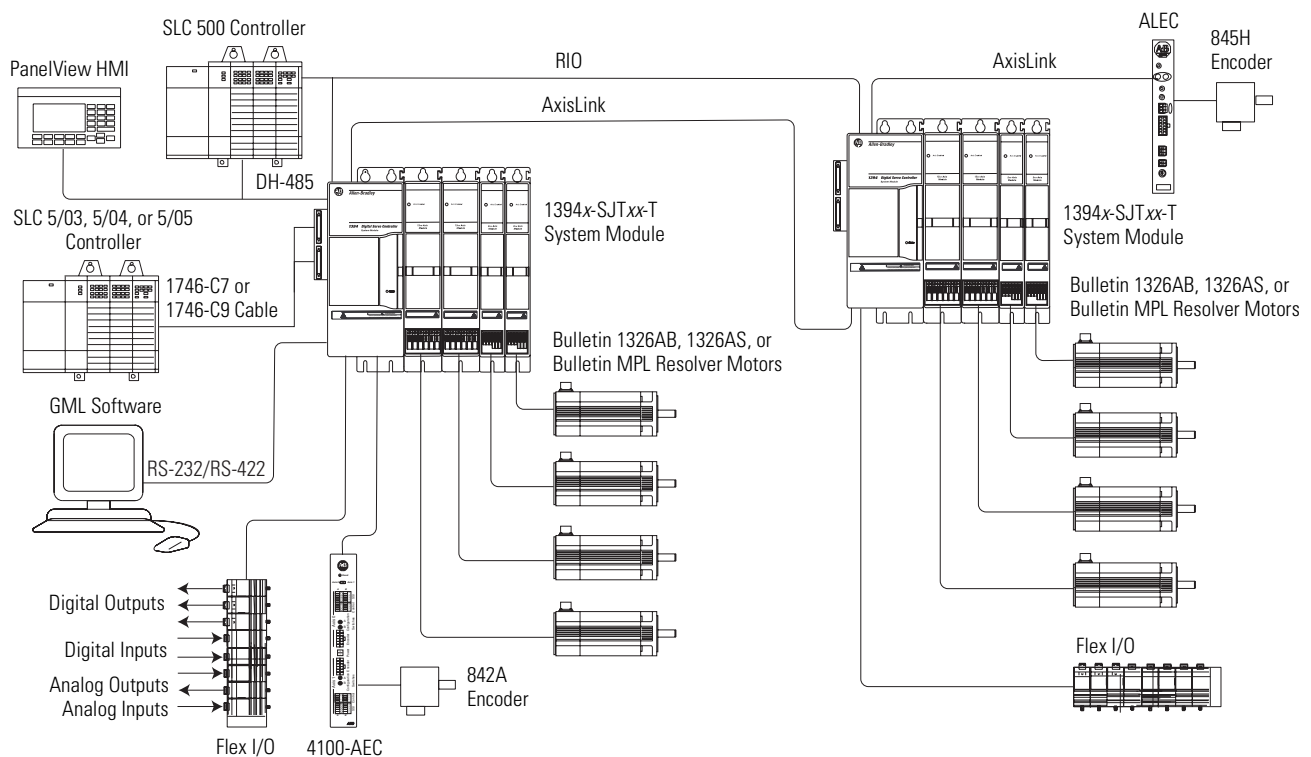
## GMC Systems

The 1394 GMC System provides all the functionality of the IMC S Class Compact Motion Controller and power conversion within the 1394 system module. The 1394x-SJTxx-C (standard GMC) system module supports four axis modules and provides four channels of auxiliary encoder input. The 1394C-SJTxx-L (standard GMC) module provides the same functionality as the 1394x-SJTxx-C module, but supports only one axis module and provides two channels of auxiliary encoder input.

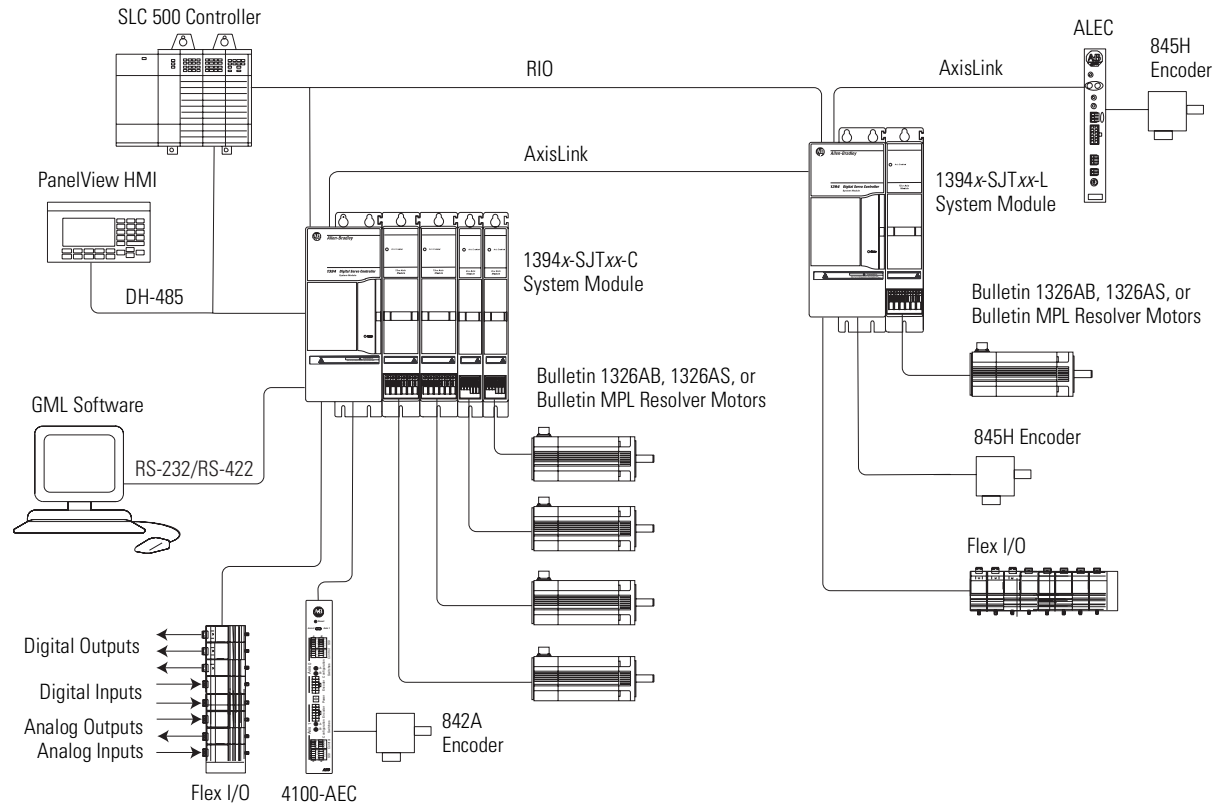
The 1394x-SJTxx-T (GMC Turbo) system module provides more GML application program memory and executes the programs faster. The 1394x-SJTxx-T module offers 64 K of memory with a 32-bit processor while the 1394x-SJTxx-C module offers 32 K of program memory with a 16-bit processor. The 1394x-SJTxx-T module also includes a direct, high speed link to the SLC controller rack that simplifies the programming required to transfer data between the 1394x-SJTxx-T module and the SLC controller.

Both systems are completely programmed and commissioned using GML (Graphical Motion Control Language) software, offer Allen-Bradley DH-485, RS-232, and RS-422 as standard communication, and have Remote I/O (RIO) and AxisLink available as communication options.

## GMC Turbo Example Systems



## Standard GMC Example Systems



This table provides a checklist of considerations when migrating from a GMC or GMC Turbo system module. This includes catalog numbers 1394x-SJTxx-C, 1394C-SJTxx-L and 1394x-SJTxx-T.

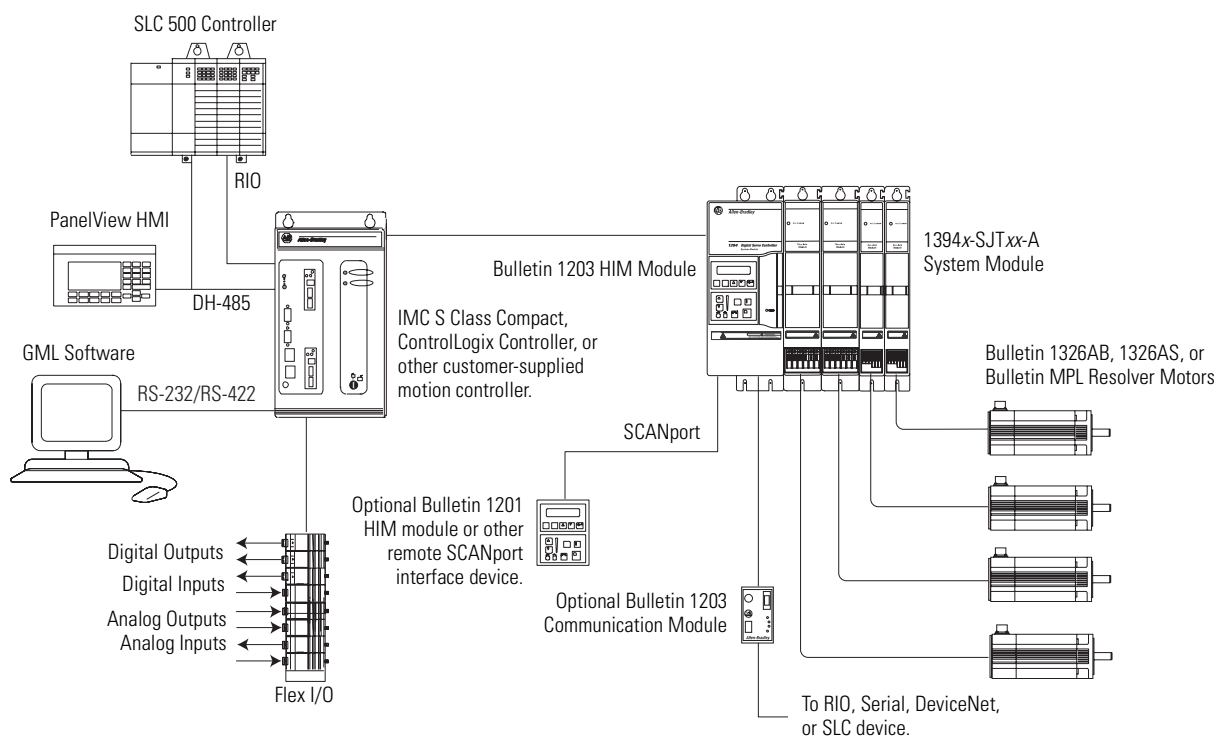
### Checklist for 1394 GMC Conversions

1394 GMC Feature/Function	Page	Kinetix 6000 Conversion	√
The 1394 GMC motion controller system uses GML software for motion programming.	59	The Kinetix 6000 drives are configured and programmed using RSLogix 5000 software and communicate over the SERCOS fiber-optic network through a ControlLogix, CompactLogix, or SoftLogix SERCOS interface module/PCI card.	
GML software is a sequential-based programming language. Therefore, when two axis are synchronized this way they are moved or executed at the same time.	59	RSLogix 5000 software is a scan-based language, the performance or execution is not immediate, instead it is based on the Motion Group Coarse Update Rate (CUR). A general rule of thumb is to expect execution no longer than 2x the CUR. In most instances of machine performance, this will not be noticeable.	
Remote I/O (RIO) adapter or DH-485 serial port. <ul style="list-style-type: none"> <li>Used to handshake PLC-5 I/O with data bit or block data transfer to and from the 1394 GMC system module.</li> <li>Used to interface to an HMI terminal.</li> </ul>	62	The RIO and DH-485 features are replaced by a Logix module and RSLogix 5000 software, which uses one program to manage I/O, process data, and command motion instructions.  The existing PLC-5 and HMI terminal/screens can be reused, but the interface to Logix needs to be retrofitted to accommodate the new controller platform.	
The 1394 GMC Turbo motion controller system uses the SLC or backplane interface to transfer I/O data bits/words.	63	The SLC interface is replaced by a Logix module and RSLogix 5000 software, which uses one program to manage I/O, processing, and motion instructions.	
DH-485 serial port.	62	The Kinetix 6000 does not have a serial port. All configuration of the drives and motion programming is done in the RSLogix 5000 software.	
RS-232/RS-422 serial ports used for multi-drop communication to different 1394 GMC motion controllers.	72		
AxisLink with an ALEC module to link multiple motion controllers to provide real-time axis coordination between axes in a distributed 1394 GMC multi-axis system.	72	AxisLink is not required since you can have multiple Kinetix 6000 power rails with up to 32 axes per motion group, per processor. Axes can be geared to one another in the same motion group or different processor motion groups.	
Flex I/O modules for local I/O used in the GML code for machine control.	73	The Kinetix 6000 drive does not support flexible inputs such as Flex I/O. However, the Logix platforms have various input and output modules to replace a Flex I/O block. The existing Flex I/O blocks can be used with a network configuration (such as ethernet) to tie into the Logix platform.	
Drive Interface Module (DIM) is used to control an external $\pm 10V$ velocity or torque control drive input. The drive must also produce an AQB quadrature encoder output signal for closed loop feedback to the 1394 GMC system.	79	The Kinetix 6000 drive does not support an analog input, nor can it control an analog input type drive. The 1756-M02AE (AQB feedback) or 1756-M02AS (SSI feedback) analog modules support control of up to two $\pm 10V$ velocity or torque control drive inputs.	
Bulletin 4100-AEC, 4100-TEC, or 4100-REC modules.	125	The Bulletin 4100 modules are not required. A multi-turn Stegmann encoder can be interfaced directly to the Auxiliary Feedback (AF) connector on the Kinetix 6000 IAM/AM modules.	

## Analog Servo System

The 1394 Analog servo system (catalog numbers 1394x-SJTxx-A) provides a traditional  $\pm 10\text{V}$  dc analog interface. The 1394 Analog system supports up to four axes and can be used as a velocity or torque control system. It is commissioned with the Bulletin 1201 HIM module which provides access to auto-tuning and start-up prompting. The 1394 Analog system also provides a SCANport interface as a standard feature.

### Analog Servo System

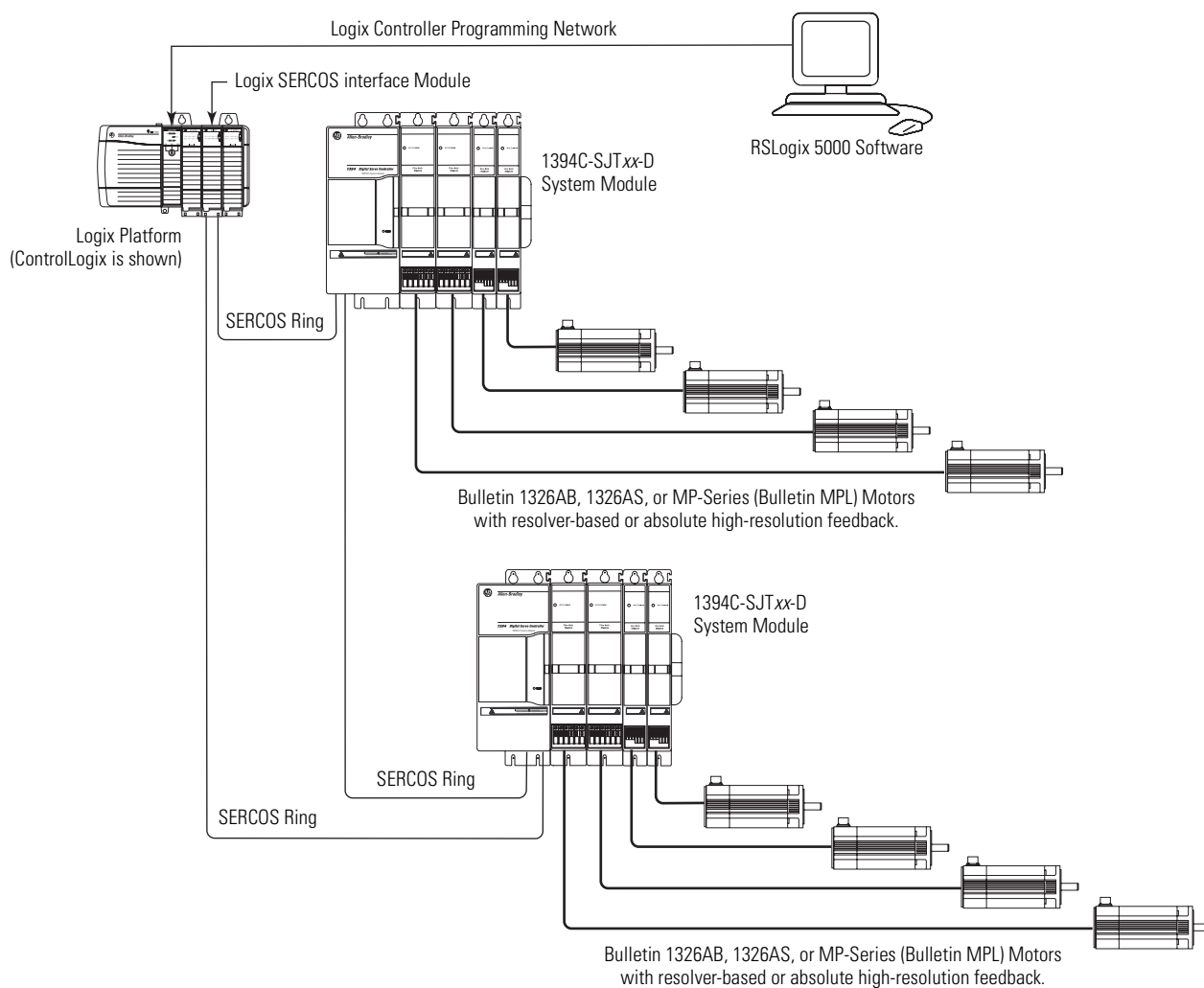


The Kinetix 6000 drives and Logix platforms provide position, velocity, or torque loop control using RSLogix 5000 software. Based on existing machine needs, select appropriate Logix controller, SERCOS module, and Kinetix 6000 drive combination.

## SERCOS System

The 1394 SERCOS system module (catalog numbers 1394C-SJTxx-D) is a digital servo drive system with a fiber-optic digital network interface. The 1394 SERCOS system is configured using either ControlLogix, CompactLogix, or SoftLogix controller platforms and RSLogix 5000 software.

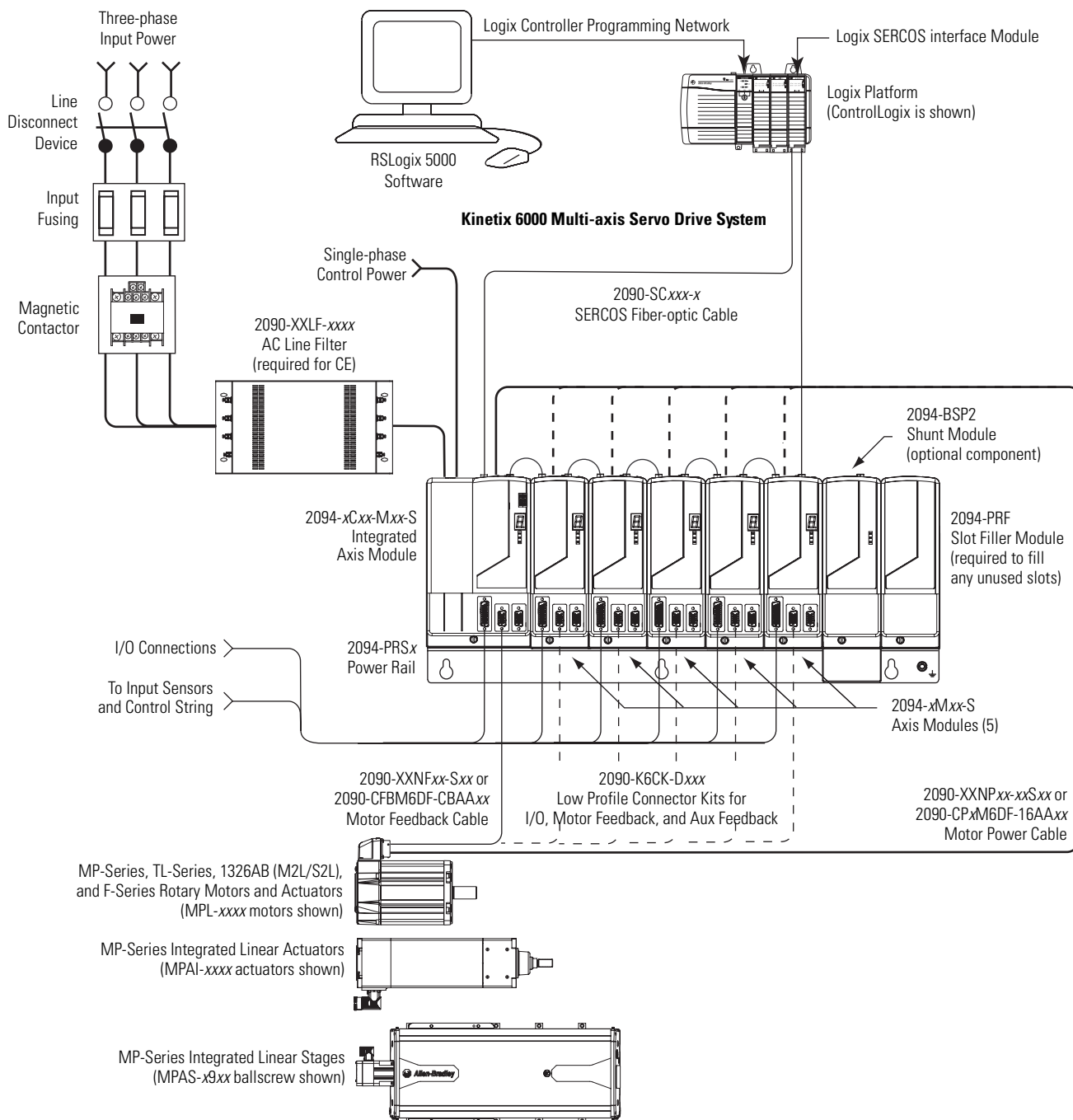
### SERCOS System







### Typical Configuration - Kinetix 6000 System (without LIM module)

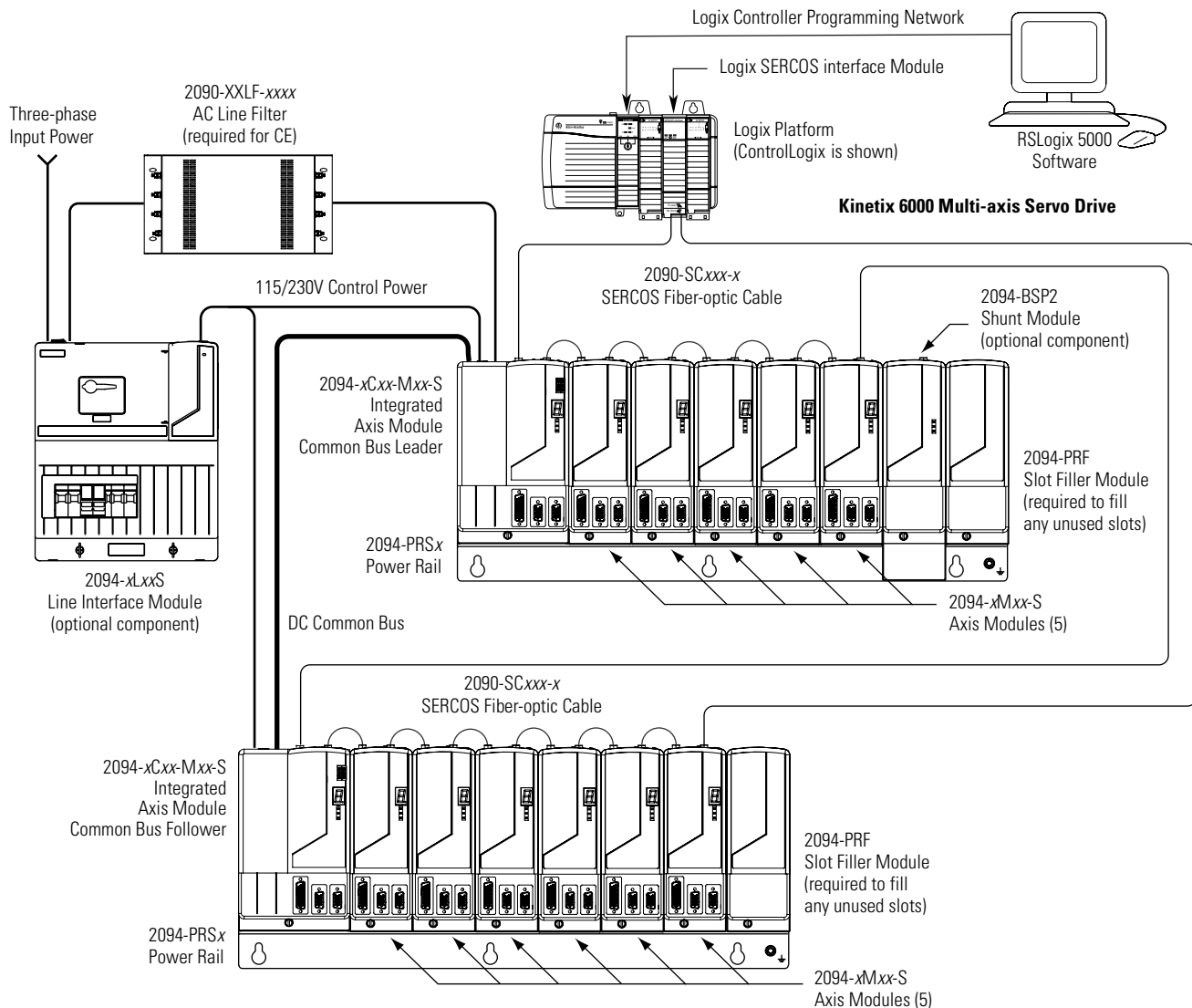


In the DC Common Bus example, the leader IAM is connected to the follower IAM via the dc common bus based on system needs for regeneration or configuration requirements. When planning your panel layout, you must configure the common-bus master to include the common-bus follower capacitance, since it controls system precharge and shunt control. Refer to the Kinetix 6000 Servo Drive User Manual, publication [2094-UM001](#), when making this calculation.

## IMPORTANT

If total bus capacitance of your system exceeds the leader IAM pre-charge rating, the IAM seven-segment status will display error code E90 (pre-charge time-out fault) if input power is applied. To correct this condition, you must replace the leader IAM with a larger module or decrease the total bus capacitance by removing axis modules.

### Typical Configuration - Kinetix 6000 System (DC Common Bus)



Motors and other details common to both three-phase ac and dc common-bus configurations are removed.

## Logix Controller Platforms

ControlLogix and CompactLogix controller platforms include SERCOS modules for interfacing with the Kinetix 6000 servo drives.

### ControlLogix Controller Platform

The ControlLogix platform is a modular system capable of handling your most intensive applications. Modules are inserted into slots on the ControlLogix chassis.

The ControlLogix SERCOS modules available for your motion control application include:

- 1756-M03SE, 1756-M08SE, and 1756-M16SE SERCOS interface modules that can accommodate up to 3, 8, and 16 axes, respectively.
- 1756-L60M03SE combination controller and SERCOS interface module that can accommodate up to 3 axes.

For more information regarding the ControlLogix platform, refer to the ControlLogix Selection Guide, publication [1756-SG001](#).

### CompactLogix Controller Platform

The CompactLogix platform is a modular system that provides cost-effective control for smaller applications. Modules snap together side-by-side on a DIN rail.

The CompactLogix SERCOS module available for your motion control application is the 1768-M04SE SERCOS interface module and accommodates up to 4 axes. Each 1768-L45 CompactLogix system can hold one or two SERCOS modules for up to 8 real, 4 auxiliary, and 6 virtual axes.

For more information regarding the CompactLogix platform, refer to the CompactLogix Selection Guide, publication [1769-SG001](#).

### SoftLogix Controller Platform

A simple SoftLogix system can consist of a single, standalone computer and its networked devices. For more robust systems, use I/O in multiple platforms distributed over multiple I/O links. These devices all reside on a virtual backplane displayed on your computer.

The SoftLogix products available for your motion control application include:

- 1784-PM16SE SERCOS interface PCI card.
- 1784-PM02AE analog servo PCI card.

For more information regarding the SoftLogix platform, refer to the SoftLogix5800 Selection Guide, publication [1789-SG001](#).

## 1394 to Kinetix 6000 Drive Conversions

Use these tables as a starting point for your 1394 to Kinetix 6000 drive conversion.

### 1394 System Module to Kinetix 6000 IAM Conversions

1394 System Module Cat. No.	1394 Drives			Kinetix 6000 IAM Cat. No.	Kinetix 6000 Drives	
	Continuous Output Current A dc	Continuous Output Power kW			Continuous Output Current A dc	Continuous Output Power kW
1394x-SJT05	7.36	5.0	--->	2094-BC01-M01-S	10.0	6.0
1394x-SJT10	14.7	10.0	--->	2094-BC02-M02-S	24.0	15.0
1394x-SJT22	33.8	22.0	--->	2094-BC04-M03-S	43.0	27.6

### 1394 Axis Module to Kinetix 6000 AM Conversions

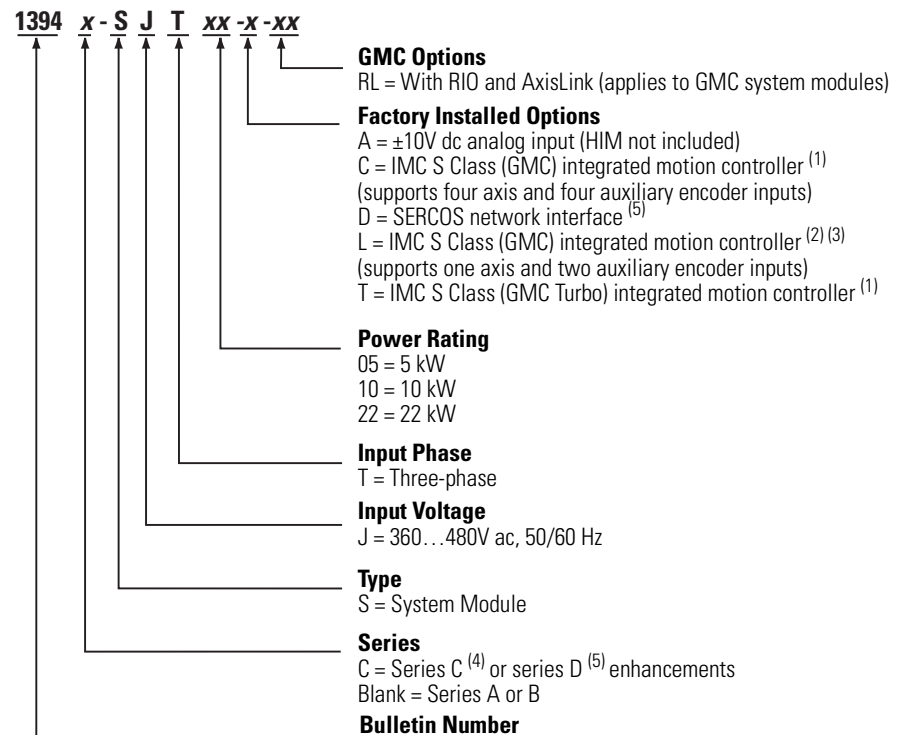
1394 Axis Module Cat. No.	1394 Drives			Kinetix 6000 AM Cat. No.	Kinetix 6000 Drives	
	Continuous Output Current A rms	Continuous Output Power kW			Continuous Output Current A rms	Continuous Output Power kW
1394x-AM03	3.0	2.0	--->	2094-BMP5-S	2.80	1.8
			--->	2094-BM01-S	6.10	3.9
1394x-AM04	4.5	3.0	--->	2094-BM01-S	6.10	3.9
1394x-AM07	7.5	5.0	--->	2094-BM02-S	10.3	6.6
1394x-AM50	23.3	15.6	--->	2094-BM03-S	21.2	13.5
1394x-AM75	35.0	23.8	--->	2094-BM05-S	34.6	22.0

## Catalog Number Explanations

Catalog numbers consist of various characters, each of which identifies a specific version or option for that component. Use these configuration charts to understand the 1394 and Kinetix 6000 drive catalog numbers.

### Catalog Numbers for 1394 Drives

#### 1394 System Modules



<sup>(1)</sup> The standard GMC and GMC Turbo system modules are identical except that the GMC Turbo (catalog number 1394x-SJTxx-T) offers a SLC backplane interface with 64 K of memory with a 32-bit processor while the standard GMC (catalog number 1394x-SJTxx-C) offers 32 K of program memory with a 16-bit processor without the SLC interface.

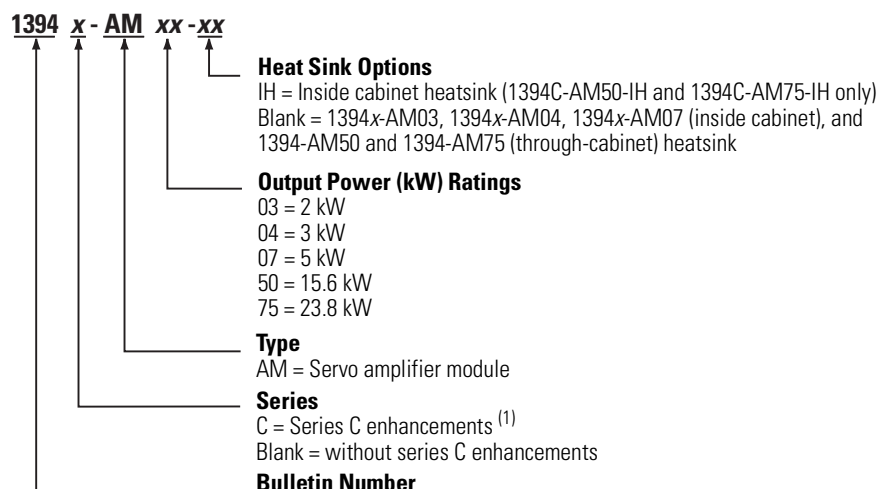
<sup>(2)</sup> The GMC system module (catalog number 1394C-SJTxx-L) is functionally the same as the standard GMC system module (catalog number 1394x-SJTxx-C) except it supports one axis and provides two auxiliary encoder inputs.

<sup>(3)</sup> The GMC system module (catalog number 1394C-SJTxx-L) is only available in 5 and 10 kW system modules.

<sup>(4)</sup> Series C system modules include Smart Power, improved terminations, and EMI filtering.

<sup>(5)</sup> Series D system modules include faster SERCOS communication and ring rates.

## 1394 Axis Modules



<sup>(1)</sup> Series C axis modules have improved terminations and EMI filtering.

## 1394 Series Change

Series C system modules (catalog numbers 1394C-SJTxx-x) and axis modules (catalog numbers 1394C-AMxx and 1394C-AMxx-IH) include features not available on series A and B modules (catalog numbers 1394-SJTxx-x and 1394-AMxx).

### System Module Features

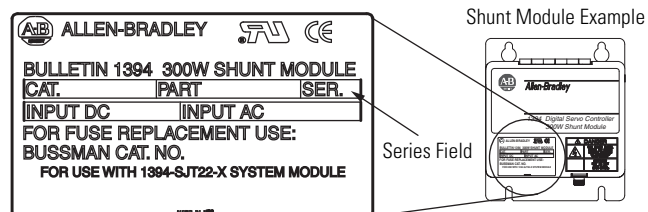
Features	Series C and D	Series A and B
Connector (plug-in) input power termination	Yes	No
Cable Clamp (strain relief, shield bond)	Yes	No
EMI filter (24V input power, registration)	Yes	No
Smart Power (Soft Start, power monitor)	Yes	22 kW systems only

### Axis Module Features

Features	Series C	Series A and B
Cable Clamp (strain relief, shield bond)	Yes	No
EMI filter (motor brake and thermal circuit)	Yes	No

To determine the series designator, check the series field on the Allen-Bradley label attached to your system, axis, and shunt modules. The series designator is located as shown in the example below.

### Allen-Bradley Label

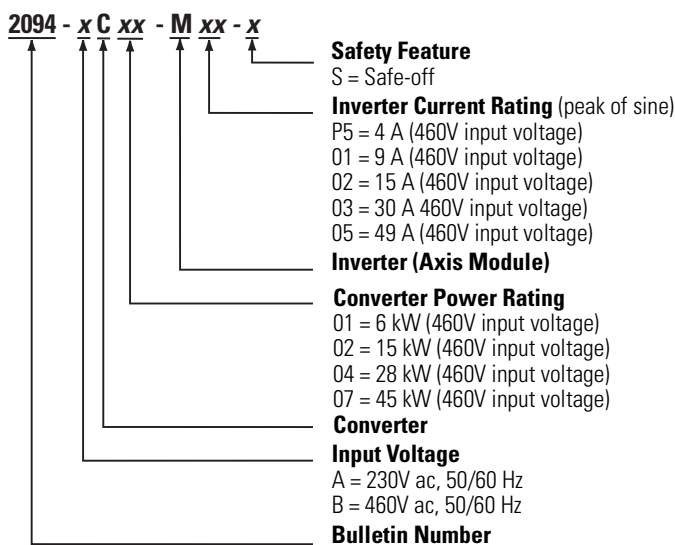


### Series Catalog Numbers for 1394 Drive Modules

1394 Modules	Module Functionality	Series D	Series C	Series A and B
System modules	Analog	N/A	1394C-SJTxx-A	1394-SJTxx-A
	GMC		1394C-SJTxx-C	1394-SJTxx-C
	GMC Turbo		1394C-SJTxx-T	1394-SJTxx-T
	GMC (1.5 axis)		1394C-SJTxx-L	N/A
	SERCOS interface	1394C-SJTxx-D	1394C-SJTxx-D	N/A
Axis modules	Inverter (no heatsink)	N/A	1394C-AM03, 1394C-AM04 and 1394C-AM07	1394-AM03, 1394-AM04 and 1394-AM07
	Inverter (external heatsink)		1394C-AM50 and 1394C-AM75	1394-AM50 and 1394-AM75
	Inverter (internal heatsink)		1394C-AM50-IH and 1394C-AM75-IH	N/A

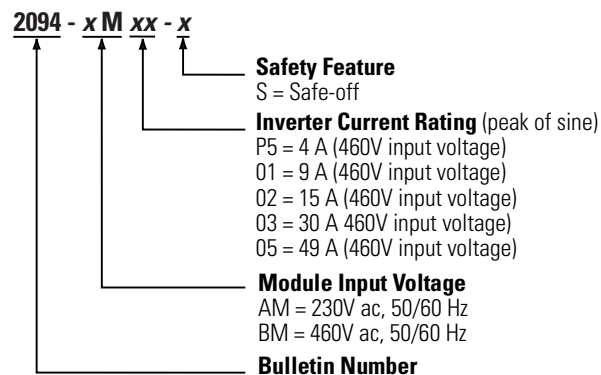
## Catalog Numbers for Kinetix 6000 Drives

### Kinetix 6000 IAM Module Catalog Numbers

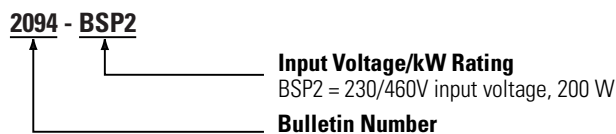




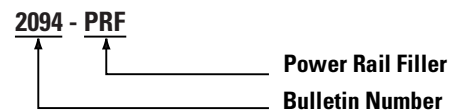
### Kinetix 6000 AM Module Catalog Numbers



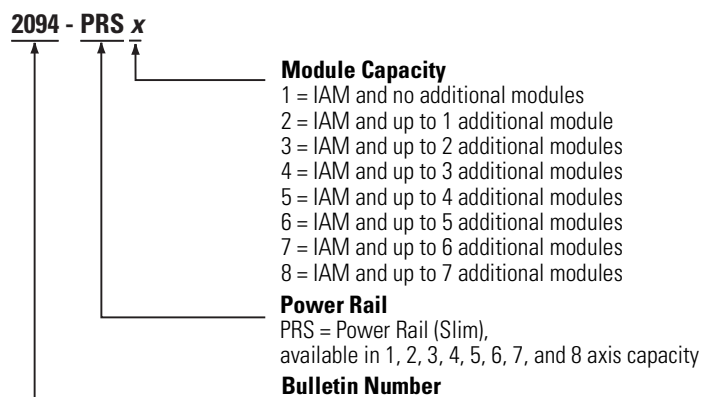
### Kinetix 6000 SM Module Catalog Numbers



### Kinetix 6000 Slot Filler Module Catalog Numbers



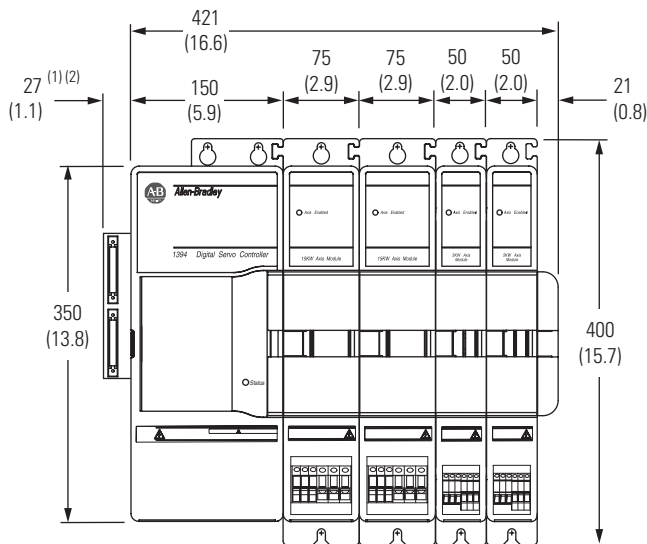
### Kinetix 6000 Power Rail Catalog Numbers



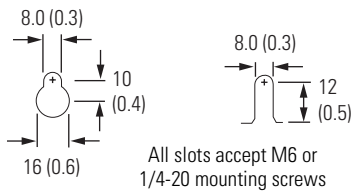
## Mounting Dimension Differences

These drawings illustrate the mounting differences between the 1394 drive systems and the Kinetix 6000 drive systems with Bulletin 2094 power rails.

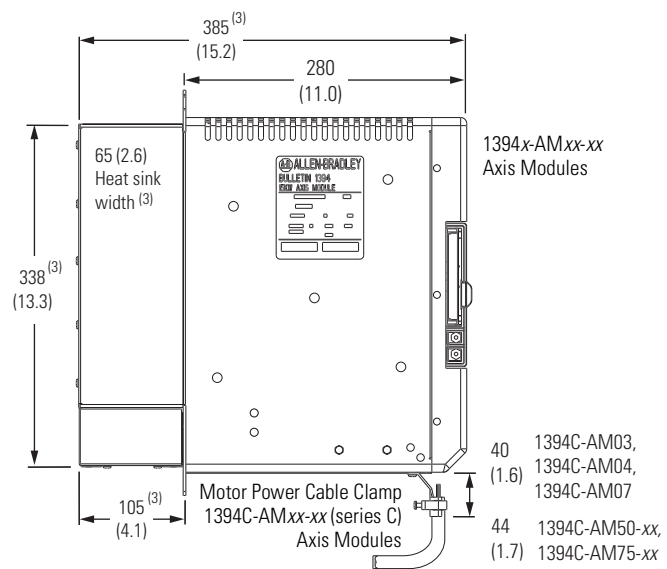
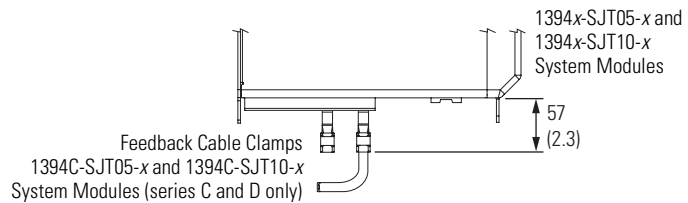
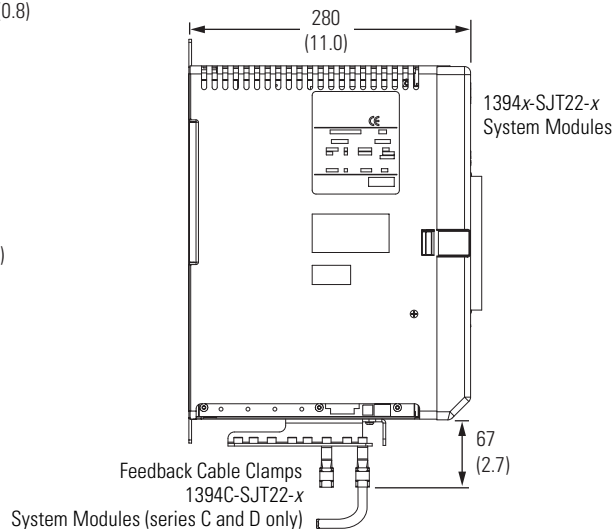
### 1394 Multi-axis System Dimensions



**Mounting Hole Detail**

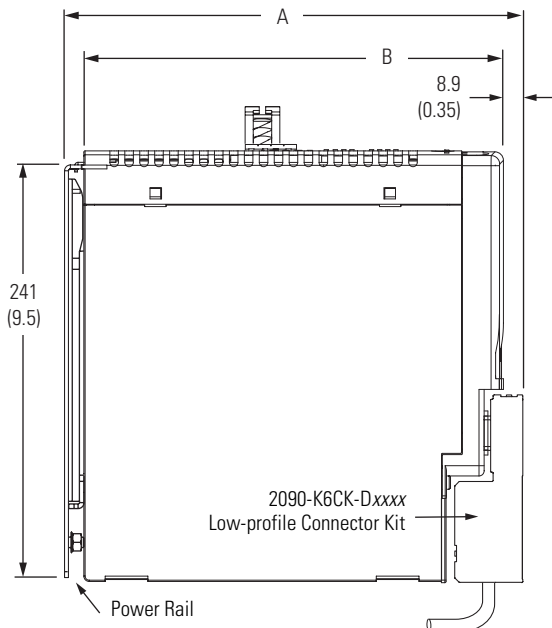
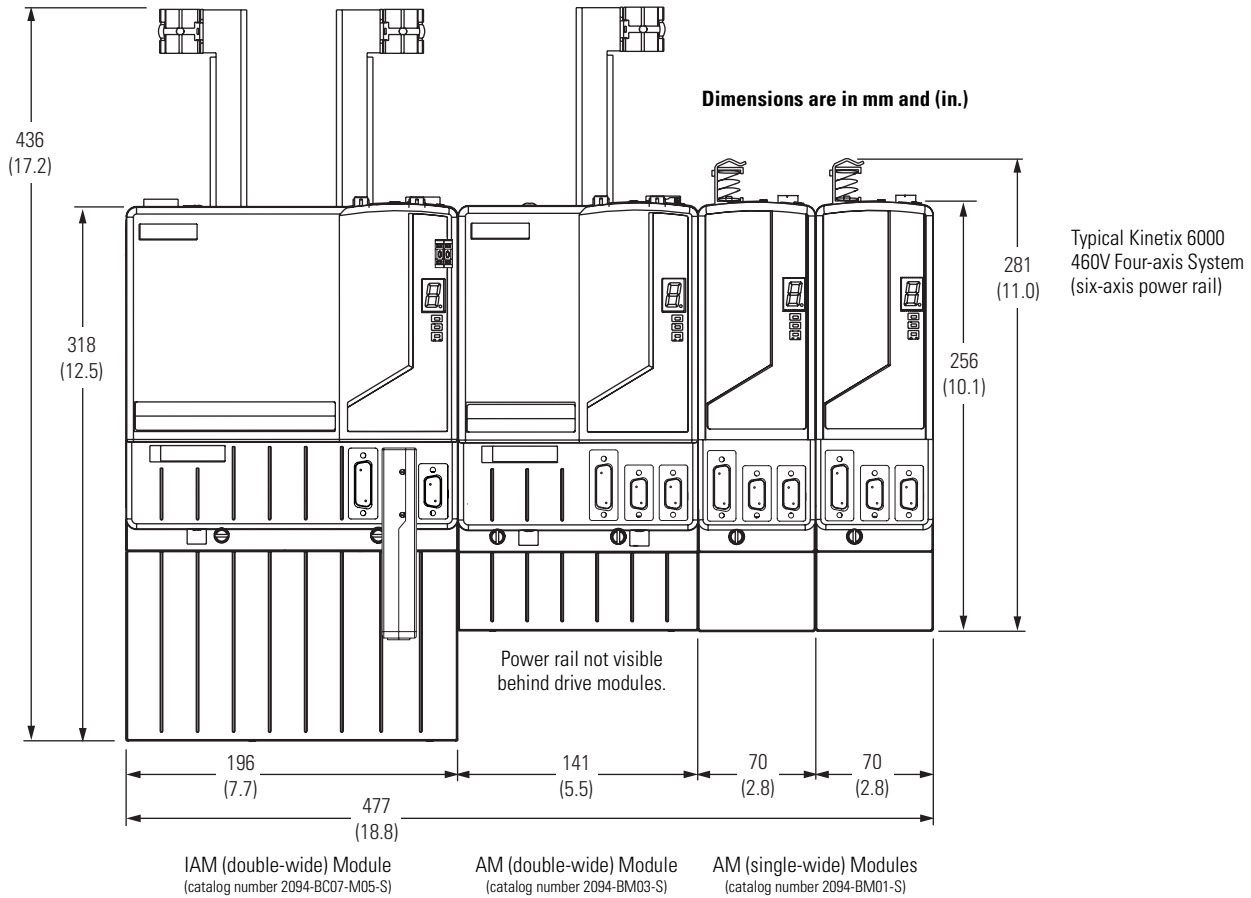


Dimensions are in mm and (in.)



- (1) This dimension only applies to GMC Turbo (catalog number 1394x-SJTxx-T) system modules.
- (2) 1394x-SJTxx-T system modules, require an additional 101.6 mm (4.0 in.) of clearance to the left of the system module to allow for connecting the SLC interface cable (catalog number 1747-C7 or 1747-C9).
- (3) These dimensions only apply to 1394x-AM50 and 1394x-AM75 axis modules.

### Kinetix 6000 Multi-axis System Dimensions



### Kinetix 6000 System Dimensions

460V IAM and AM Modules	
Dimension A mm (in.)	Dimension B mm (in.)
272 (10.7)	249 (9.8)

### Low-profile Connector Kits

Cat. No.	Connector Designator	Connector Type
2090-K6CK-D15M	MF	Motor feedback
2090-K6CK-D15MF		Motor feedback with filter
2090-K6CK-D15F	AF	Auxiliary feedback
2090-K6CK-D26M	IOD	I/O

## Kinetix 6000 Drive Modules

This section contains selection information and mounting dimensions for the Bulletin 2094 power rail, shunt module, and slot filler modules.

### Kinetix 6000 Power Rail Specifications

The Kinetix 6000 IAM, AM, SM, and slot-filler modules hang on the Bulletin 2094 power rail, which comes in sizes from 1...8 axes.

#### IAM, AM, and SM Module Slot Requirements

IAM Cat. No.	Converter Slot Used	Inverter Slots Used
2094-BC01-MP5-S	460V 1	1
2094-BC01-M01-S		1
2094-BC02-M02-S		1
2094-BC04-M03-S		2
2094-BC07-M05-S		2

AM Cat. No.	Converter Slot Used	Inverter Slots Used
2094-BMP5-S	460V 0	1
2094-BM01-S		1
2094-BM02-S		1
2094-BM03-S		2
2094-BM05-S		2

SM Cat. No.	Converter Slot Used	Inverter Slots Used
2094-BSP2	230/ 460V 0	1

2094-BC04-M03-S and 2094-BC07-M05-S IAM modules, and 2094-BM03-S and 2094-BM05-S AM modules are double-wide modules that require two inverter slots on the power rail.

The leftmost slot on each power rail is the converter slot and only used by the IAM. All other slots are inverter slots and are used by the IAM, AM, or SM. The power rail catalog number indicates the number of available inverter slots.

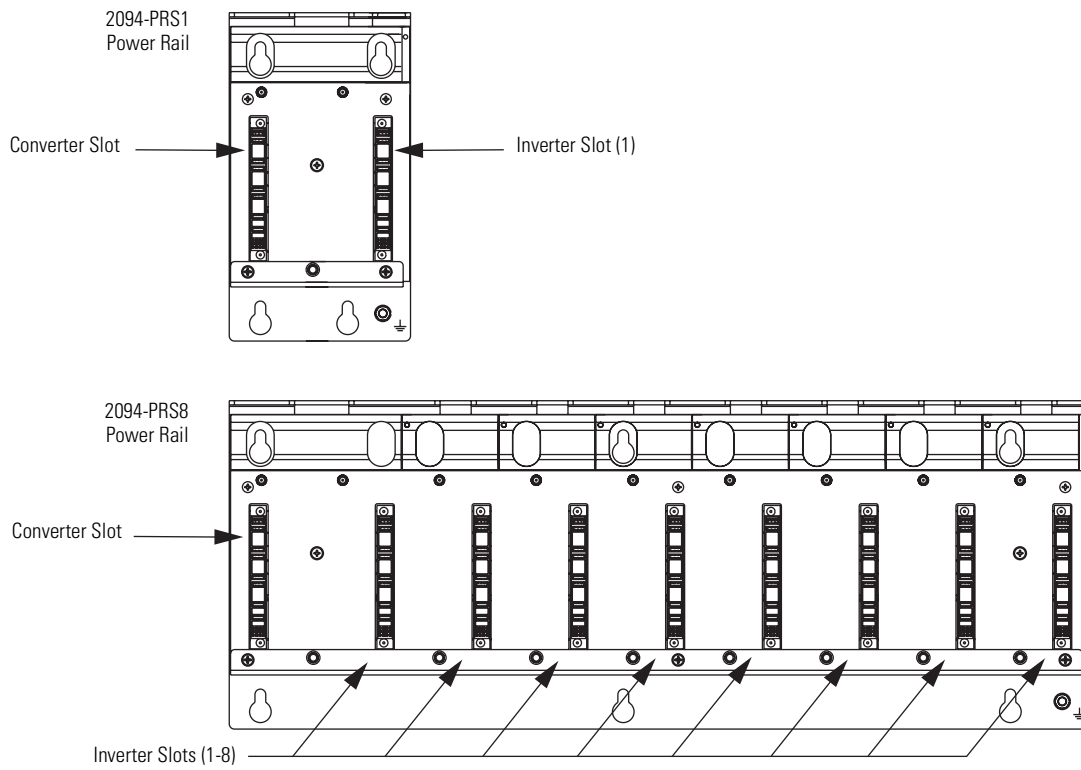
For example, the Bulletin 2094-PRS1 power rail contains one inverter slot. This limits the use of this power rail to systems requiring only one axis (inverter slot). Similarly, the Bulletin 2094-PRS8 power rail contains eight inverter slots. This limits the use of this power rail to systems requiring up to eight axes (inverter slots).

When selecting a power rail, determine the number of inverter slots required by all rail-mounted modules and choose a power rail with that minimum number of inverter slots.

#### IMPORTANT

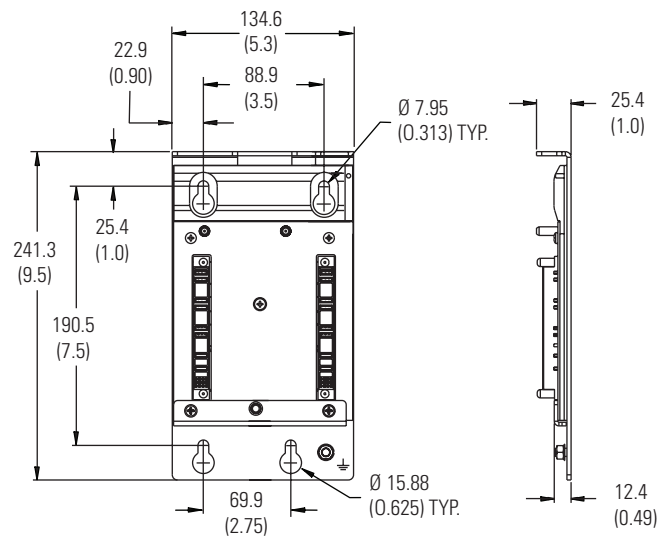
If you select a power rail with slots exceeding the minimum required for your system, you must install a slot filler module (catalog number 2094-PRF) in each unused slot.

### Power Rail Slot Examples

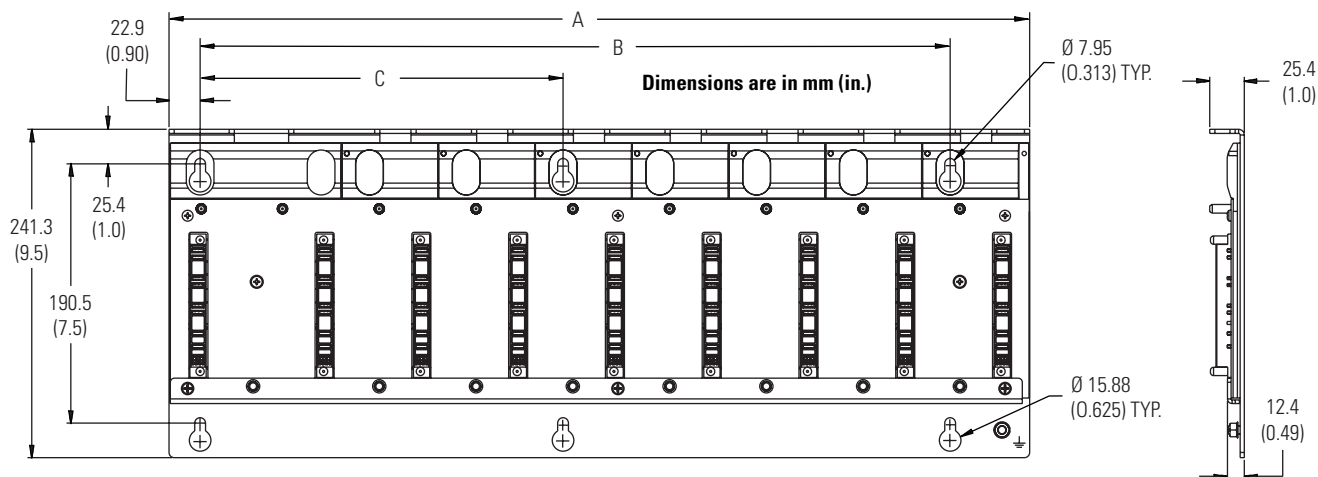


### 2094-PRS1 (Slim) Power Rail Dimensions

Dimensions are in mm (in.)



**2094-PRS2, 2094-PRS3, 2094-PRS4, 2094-PRS5, 2094-PRS6, 2094-PRS7, and  
2094-PRS8 (Slim) Power Rail Dimensions**



Cat. No.	Description	Dimension A mm (in.)	Dimension B mm (in.)	Dimension C mm (in.)
2094-PRS1	Refer to figure on page 21.			
2094-PRS2	2 axis power rail	205.7 (8.10)	124.5 (4.90)	N/A
2094-PRS3	3 axis power rail	276.9 (10.90)	195.6 (7.70)	N/A
2094-PRS4	4 axis power rail	348.0 (13.70)	266.7 (10.50)	N/A
2094-PRS5	5 axis power rail	419.1 (16.50)	337.8 (13.30)	195.6 (7.70)
2094-PRS6	6 axis power rail	490.2 (19.30)	408.9 (16.10)	195.6 (7.70)
2094-PRS7	7 axis power rail	561.3 (22.10)	480.1 (18.90)	266.7 (10.50)
2094-PRS8	8 axis power rail	632.5 (24.90)	551.2 (21.70)	266.7 (10.50)

## Kinetix 6000 Shunt Module Specifications

The Kinetix 6000 shunt module (SM) (catalog number 2094-BSP2) provides an additional 200 W of shunt capacity to the drive system and is where connections to an external shunt module are made.

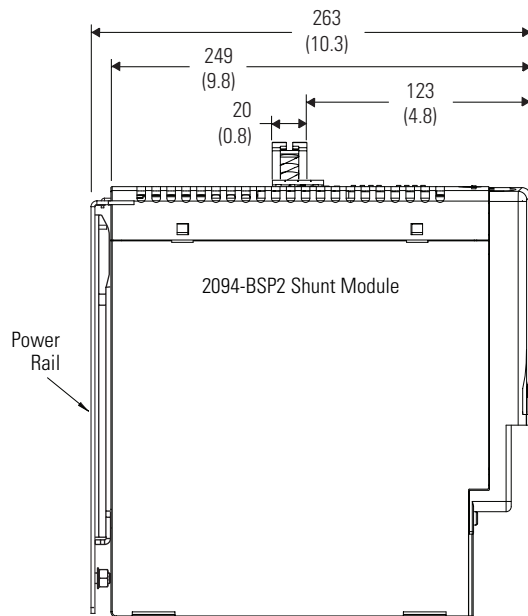
For Bulletin 1394 external shunt module catalog numbers, refer to External Shunt Modules on page 46.

### SM Module Power Specifications

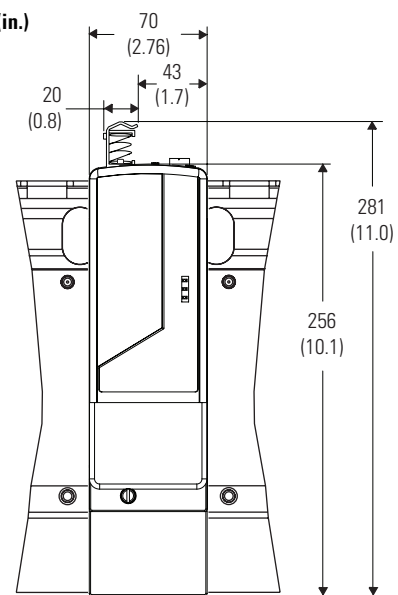
Kinetix 6000 Drives	Shunt Module Cat. No.	Specifications						Fuse Replacement
		Drive Voltage V ac	Resistance W	Peak Power kW	Peak Current A	Continuous Power W	Capacitance $\mu$ F	
2094-BCxx-Mxx-S	2094-BSP2	230	28.75	5.7	14	200	470	N/A (no internal fuse)
		460		22.5	28			

For tables with the Kinetix 6000 shunt module in combination with an IAM module internal shunt (when present) and the various external passive shunt resistors available for the Kinetix 6000 drive systems, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#). Use these tables to determine the shunt module combination you need based on the requirements of your application.

### 2094-BSP2 Shunt Module Dimensions



Dimensions are in mm (in.)



Modules are shown mounted to the power rail and the dimensions reflect that.

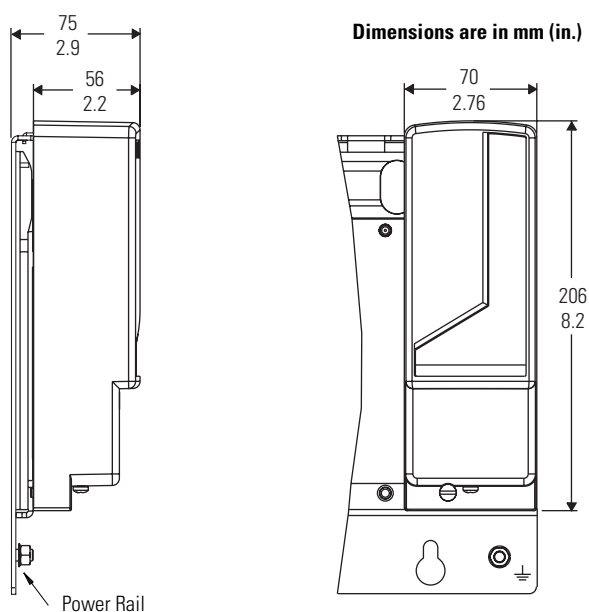
## Kinetix 6000 Slot Filler Module Specifications

The Kinetix 6000 slot filler module (catalog number 2094-PRF) fills empty slots on the power rail. Empty power rail slots provide a convenient means of adding a future AM or SM module.

**IMPORTANT**

Power rail slots not occupied by an IAM, AM, or SM module, must have a slot filler module installed.

### 2094-PRF Slot Filler Module Dimensions



Modules are shown mounted to the power rail and the dimensions reflect that.

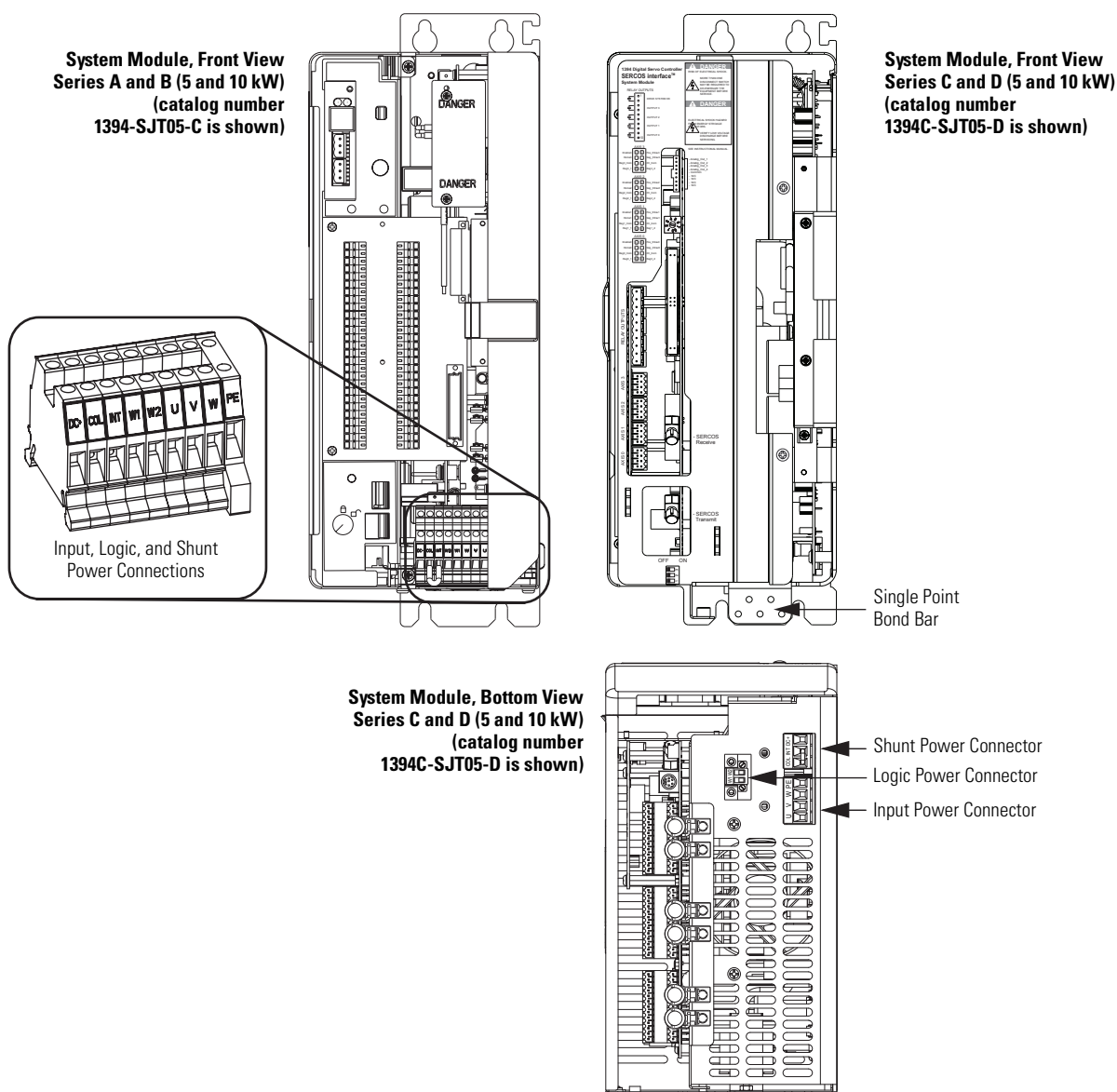


## Input Power Wiring Differences

These drawings illustrate input power wiring differences between the 1394 drives and the Kinetix 6000 drives. Differences also exist between 1394 system modules, depending on the series (series A and B, or C and D), but are not dependant on functionality (analog, GMC, GMC Turbo, or SERCOS interface).

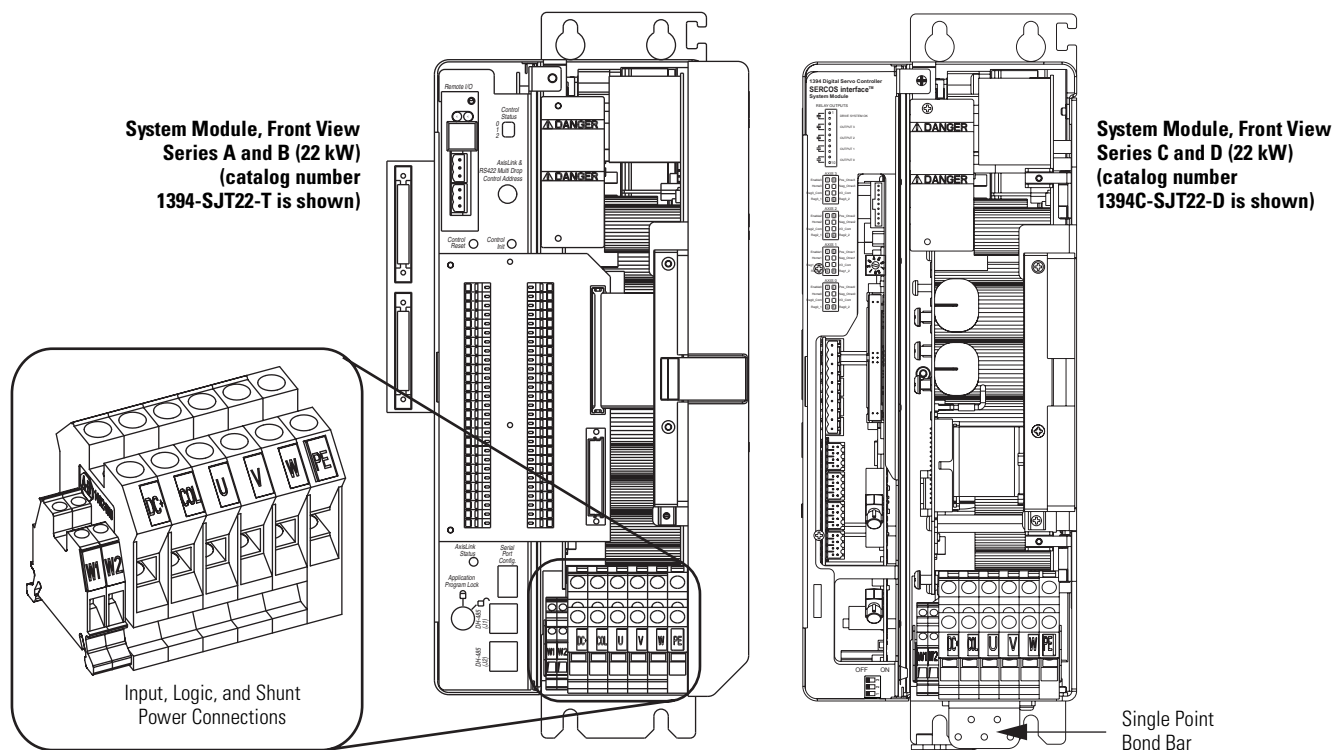
This example illustrates the power wiring differences between 1394 series A and B system modules and series C and D system modules for 5 and 10 kW systems. Series A and B system modules have terminal blocks for power wiring which was replaced by connectors on the bottom of series C and D system modules and a single-point bond bar.

### 1394 System Modules (5 and 10 kW)



The only power wiring difference between series A and B system modules and series C system modules for 22 kW systems is the addition of a single-point bond bar.

### 1394 System Modules (22 kW)



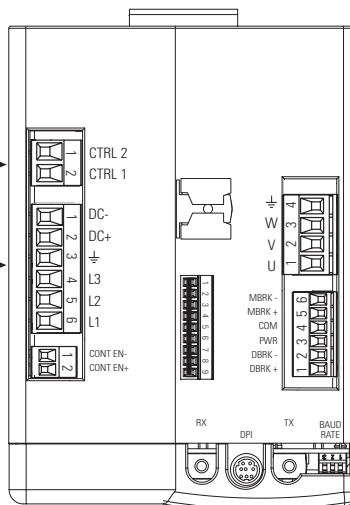
This drawing illustrates the input power wiring connections for the Kinetix 6000 IAM modules. The Bulletin 2094 power rail features a grounding stud for making a high-frequency bond, replacing the single-point bond bar on 1394 series C system modules.

### Kinetix 6000 IAM Modules

**Integrated Axis Module, Top View**  
(catalog number 2094-BC01-MP5-S is shown)

Control Power  
(CPD) Connector

DC Bus / AC Input Power  
(IPD) Connector



#### TIP

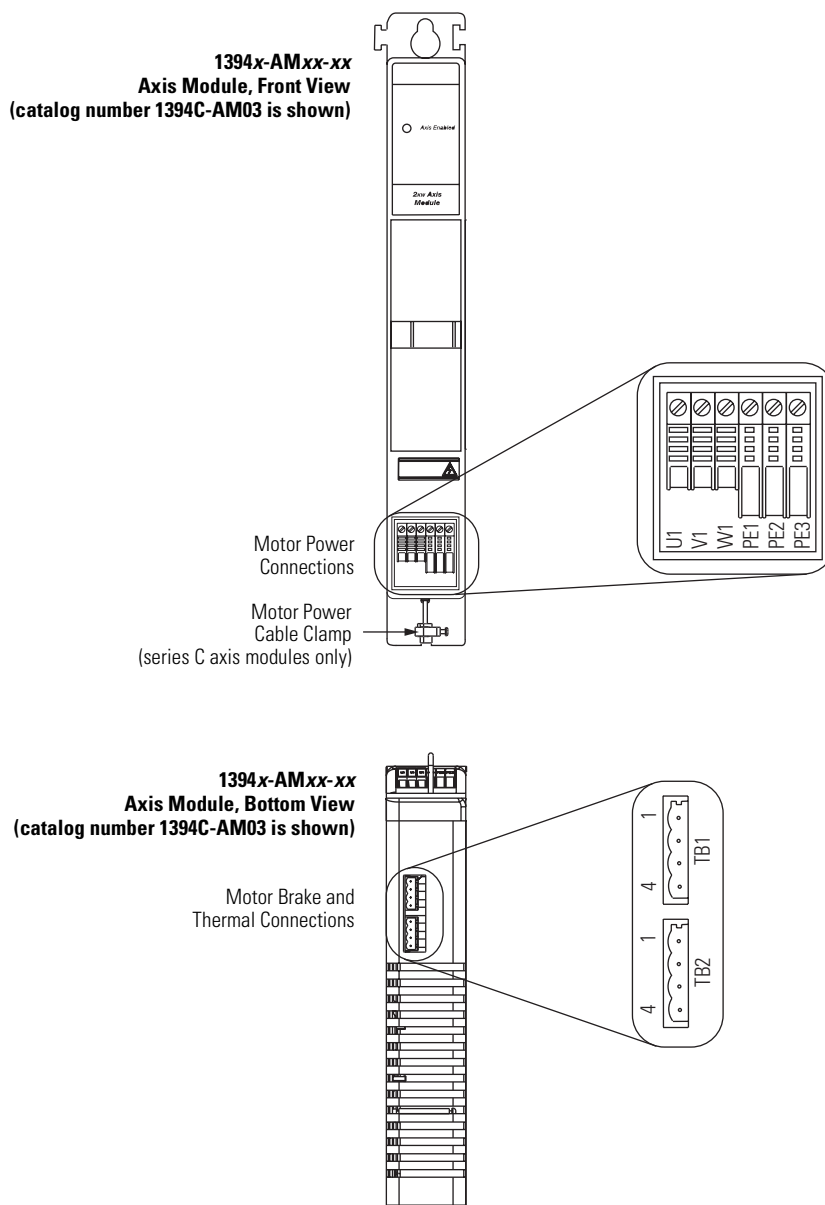
Although the physical size of some IAM modules may be larger, the location of the connectors is the same.

## Motor Power Wiring Differences

These drawings illustrate motor power wiring differences between the 1394 drives and the Kinetix 6000 drives.

This drawing illustrates the motor power wiring for 1394 axis modules. series C axis modules included filters in the motor brake and thermal circuits, series A and B axis modules did not.

### 1394 Axis Modules



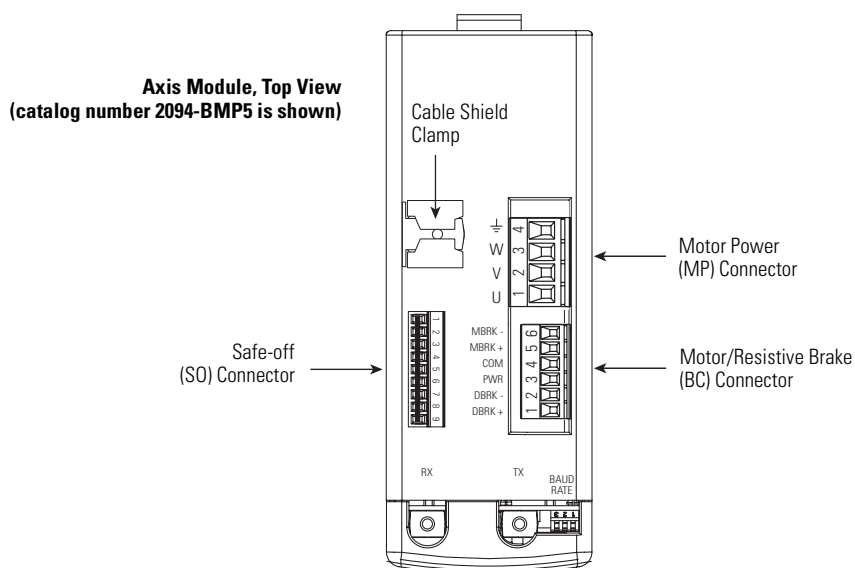
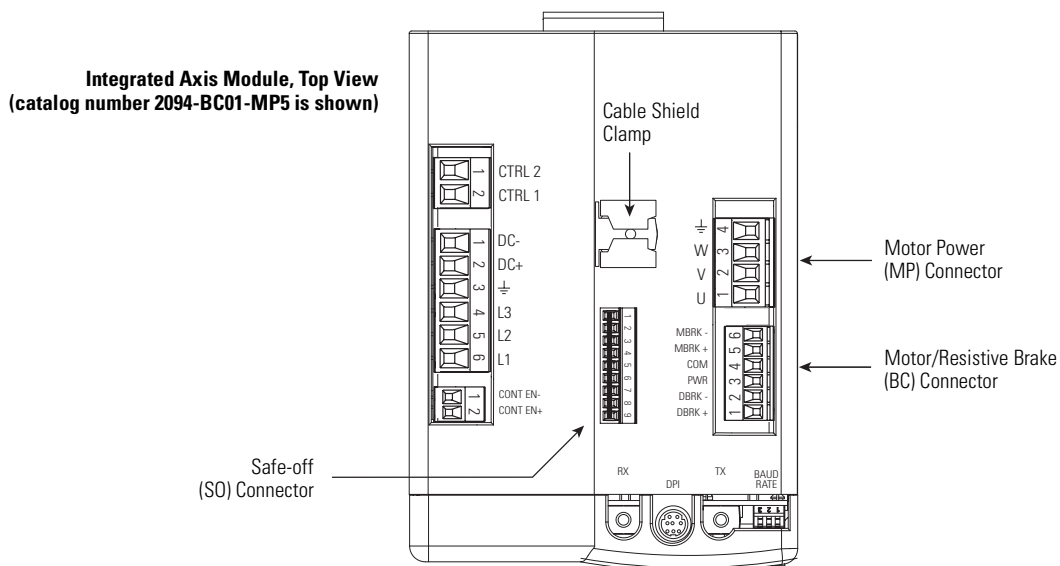
#### TIP

Although the physical size of the 1394-AM50-xx and 1394-AM75-xx modules may be larger, the location of the connectors is the same.

This drawing illustrates the motor power wiring connections for the Kinetix 6000 IAM and AM modules. Also shown is the Safe-off (SO) connector. This feature is not offered on the 1394 drive systems.

Refer to the Kinetix Safe-off Feature Safety Reference Manual, publication [GMC-RM002](#), for more information.

### Kinetix 6000 Drive Modules



#### TIP

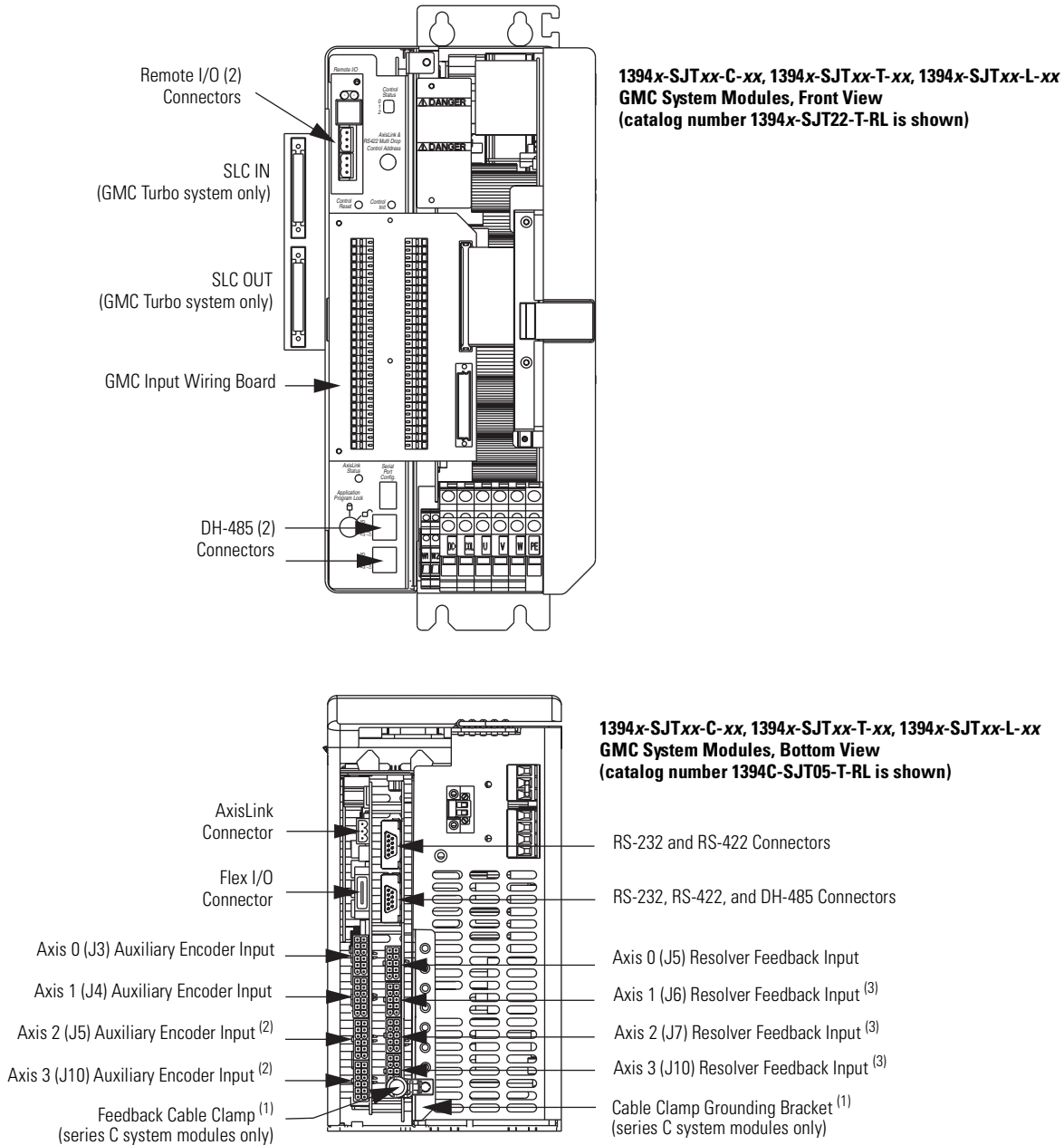
Although the physical size of some IAM and AM modules may be larger, the location of the connectors is the same.

## Motor Feedback and I/O Wiring Differences

These drawings illustrate motor feedback and I/O wiring differences between the 1394 drives and the Kinetix 6000 drives. Differences also exist between 1394 system modules, depending on functionality (analog, GMC, GMC Turbo, or SERCOS interface).

This example illustrates the I/O and feedback wiring for GMC system modules.

### 1394 GMC System Modules



<sup>(1)</sup> Grounding bracket and cable clamps are only present on series C system modules.

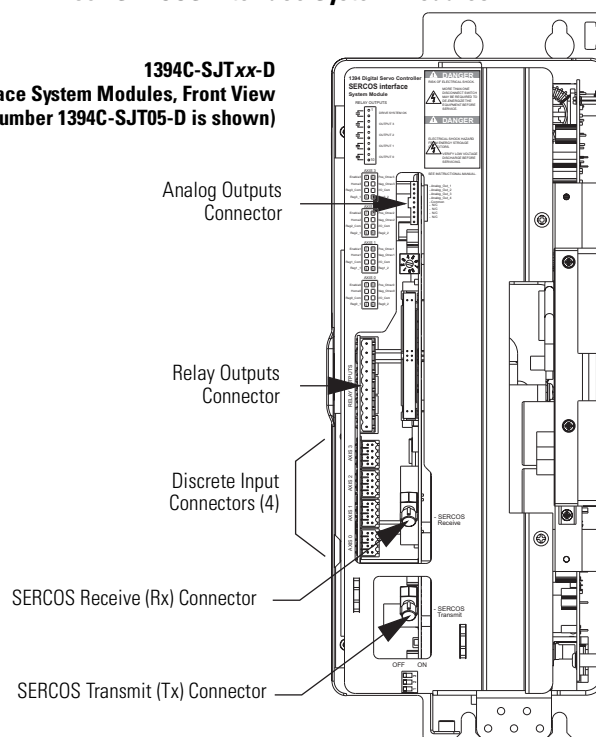
<sup>(2)</sup> Only two auxiliary encoder inputs are present on the 1394C-SJTxx-L system modules.

<sup>(3)</sup> Only one resolver feedback input is present on the 1394C-SJTxx-L system modules.

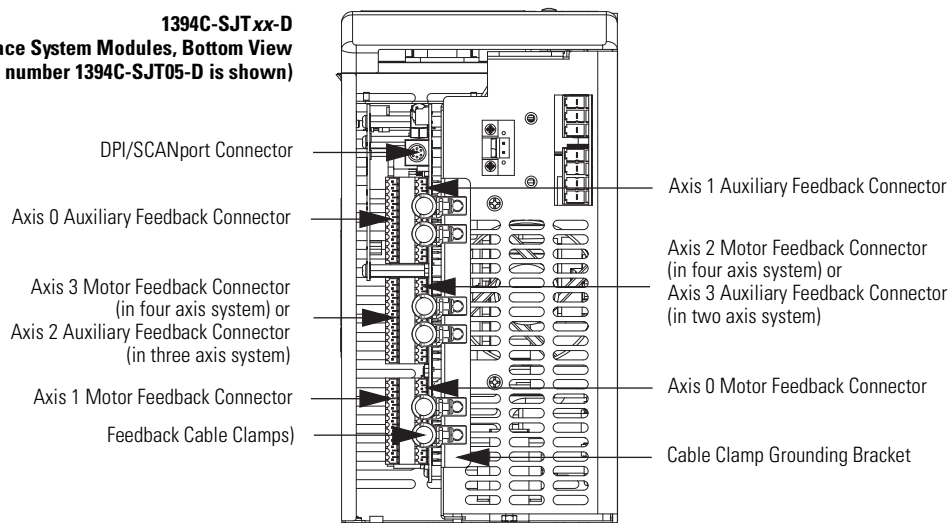
This example illustrates the I/O and feedback wiring for SERCOS interface system modules.

### 1394 SERCOS Interface System Modules

**1394C-SJTxx-D**  
SERCOS interface System Modules, Front View  
(catalog number 1394C-SJT05-D is shown)



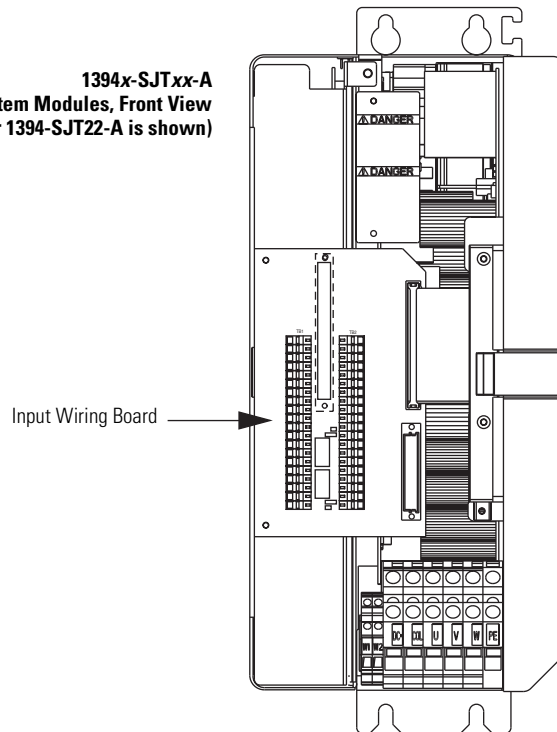
**1394C-SJTxx-D**  
SERCOS interface System Modules, Bottom View  
(catalog number 1394C-SJT05-D is shown)



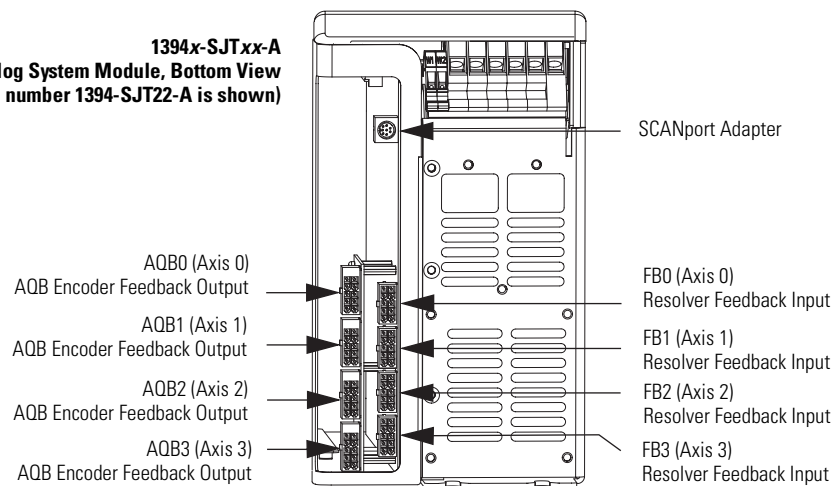
This example illustrates the I/O and feedback wiring connectors for Analog system modules.

### 1394 Analog System Modules

**1394x-SJTxx-A**  
Analog System Modules, Front View  
(catalog number 1394-SJT22-A is shown)

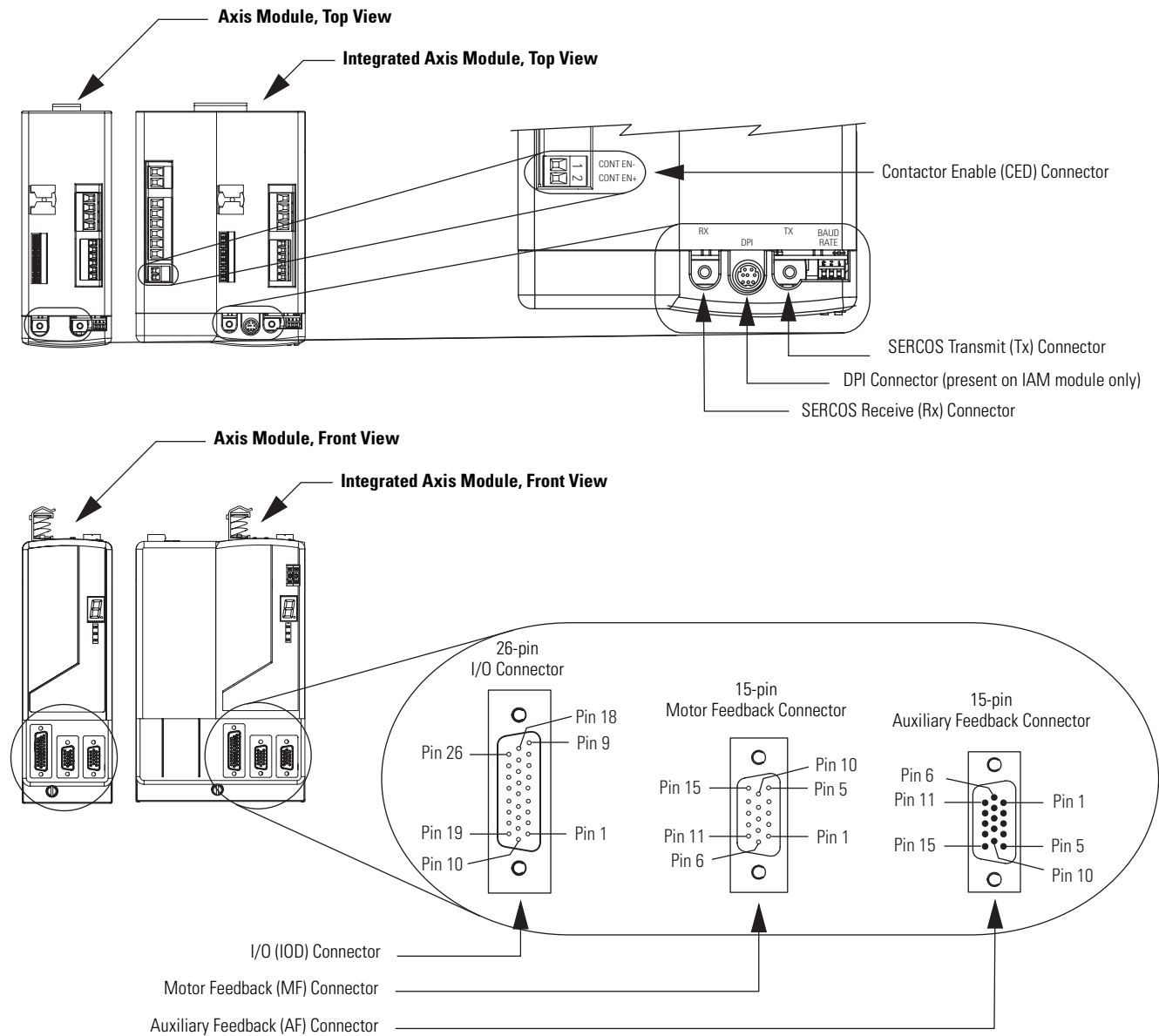


**1394x-SJTxx-A**  
Analog System Module, Bottom View  
(catalog number 1394-SJT22-A is shown)



These examples illustrate the I/O and feedback connectors for the Kinetix 6000 IAM and AM modules.

Kinetix 6000 IAM/AM Modules



Low-profile Connector Kits

Cat. No.	Connector Designator	Connector Type
2090-K6CK-D15M	MF	Motor feedback
2090-K6CK-D15MF		Motor feedback with filter
2090-K6CK-D15F	AF	Auxiliary feedback
2090-K6CK-D26M	IOD	I/O



## Converting 1394 GMC I/O and Feedback Wiring

These tables list the I/O and feedback wiring differences between 1394 GMC system modules (catalog numbers 1394x-SJTxx-C, 1394C-SJTxx-L, 1394x-SJTxx-T) and Kinetix 6000 IAM/AM modules.

### TIP

Use 2090-K6CK-D26M low-profile connector kits for wiring I/O and feedback connections to the IOD connector.

### Converting 1394 GMC Input Wiring to Kinetix 6000 Drive

1394 TB1/TB2 I/O Connector	Description	Signal Name		Kinetix 6000 I/O Connector	Description	Signal Name
TB1-1 TB2-1	System enable input on 1394 system module	SYS ENABLE	---	IOD-2	Hardware enable input on each IAM/AM module	ENABLE
TB1-4 (axis 0) TB2-4 (axis 1) TB1-10 (axis 2) TB2-10 (axis 3)	Home switch	HOME <sub>x</sub>	---	IOD-5	Home switch input	HOME
TB1-5 (axis 0) TB2-5 (axis 1) TB1-11 (axis 2) TB2-11 (axis 3)	Positive/negative overtravel limit switch	POS_OTRAV <sub>x</sub>	---	IOD-8	Positive/negative overtravel limit switch	OT+
TB1-6 (axis 0) TB2-6 (axis 1) TB1-12 (axis 2) TB2-12 (axis 3)		NEG_OTRAV <sub>x</sub>	---	IOD-11		OT-
TB1-2, 8, 14 TB2-2, 8, 14	Input common	24V INPUT COMMON	---	IOD-3, 6, 9, 12	Common for inputs	+24V_COM
Customer-supplied 24V digital input power		IO_24V	---	IOD-1, 4, 7, 10	24V digital input power	+24V_PWR
Customer-supplied 24V registration power		REG_24V	---	IOD-13, 16	24V registration power	REG_24V
TB1-17...18 (axis 0) TB2-17...18 (axis 1) TB1-21...22 (axis 2) TB2-21...22 (axis 3)	+24V dc registration input	REG1 <sub>x</sub>	---	IOD-14	High speed registration 1 input	REG1
TB1-16 (axis 0) TB2-16 (axis 1) TB1-20 (axis 2) TB2-20 (axis 3)	+5V dc registration input <sup>(1)</sup>	REG2 <sub>x</sub>	---	IOD-17	High speed registration 2 input	REG2
TB1-18 (axis 0) TB2-18 (axis 1) TB1-22 (axis 2) TB2-22 (axis 3)	Registration common	REG_COM <sub>x</sub>	---	IOD-15	Common for registration	REG_COM
TB1-7 (axis 0) TB2-7 (axis 1) TB1-13 (axis 2) TB2-13 (axis 3)	Thermal switch input	THERM FLT <sub>x</sub>	---	MF-11	Motor thermal switch (normally-closed)	TS
TB2-24...25	Drive OK relay	DRIVE OK	---	CED-1...2	Contactor enable relay	CONT EN+ CONT EN-

<sup>(1)</sup> The Kinetix 6000 drive does not support 5V dc registration inputs. REG1 (IOD-14) and REG2 (IOD-17) are 24V dc registration inputs.

### Converting 1394 GMC Resolver Feedback to Kinetix 6000 Drive

GMC System Module Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal		Kinetix 6000 MF Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal
Jx-4	Sine differential input (+)	S2	--->	MF-1	Sine differential input (+)	S2
Jx-9	Sine differential input (-)	S4	--->	MF-2	Sine differential input (-)	S4
Jx-3	Cosine differential input (+)	S1	--->	MF-3	Cosine differential input (+)	S1
Jx-8	Cosine differential input (-)	S3	--->	MF-4	Cosine differential input (-)	S3
Jx-1	Resolver excitation	R1	--->	MF-5	Resolver excitation	R1
Jx-6	Resolver excitation	R2	--->	MF-10	Resolver excitation	R2
TB1-7 (axis 0) TB2-7 (axis 1) TB1-13 (axis 2) TB2-13 (axis 3)	Motor thermal switch	TS+	--->	MF-16	Motor thermal switch <sup>(1)</sup>	TS+
		TS-	--->	MF-17		TS-
Shield Clamp	Overall Shield	Overall Shield	--->	Shield Clamp	Overall Shield	Overall Shield

<sup>(1)</sup> When using Bulletin 1326AB or 1326AS (resolver-based) motors, use 2090-K6CK-D15MF low-profile connector kits.

### Converting 1394 Analog I/O and Feedback Wiring

These tables list the I/O and feedback wiring differences between 1394 Analog system modules (catalog numbers 1394x-SJTxx-A) and Kinetix 6000 IAM/AM modules.

#### Converting 1394 Analog Input Wiring to Kinetix 6000 Drive

Analog System Module Connector	Description	Signal	Kinetix 6000 MF Connector	Description	Signal
TB1-7, TB1-14 TB2-7, TB2-14	Hardware enable input on 1394 system module	ENABLE	IOD-2	Hardware enable input on each IAM/AM module	ENABLE
TB2-16, TB2-17	Contactor enable	CONTACTOR EN	CED-1...2	Contactor enable relay	CONT EN+ CONT EN-
TB2-18, TB2-19	Drive OK relay	DROK	Not used		

#### TIP

The other 1394 Analog I/O connections become transparent due to additional Kinetix 6000 drive functionality.

#### Converting 1394 Analog Resolver Feedback to Kinetix 6000 Drive

Analog System Module Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal		Kinetix 6000 MF Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal
FBx-4	Sine differential input (+)	S2	--->	MF-1	Sine differential input (+)	S2
FBx-9	Sine differential input (-)	S4	--->	MF-2	Sine differential input (-)	S4
FBx-3	Cosine differential input (+)	S1	--->	MF-3	Cosine differential input (+)	S1
FBx-8	Cosine differential input (-)	S3	--->	MF-4	Cosine differential input (-)	S3
FBx-1	Resolver excitation	R1	--->	MF-5	Resolver excitation	R1
FBx-6	Resolver excitation	R2	--->	MF-10	Resolver excitation	R2

## Converting 1394 SERCOS I/O and Feedback Wiring

These tables list the I/O and feedback wiring differences between 1394 SERCOS system modules (catalog numbers 1394C-SJTxx-D), and Kinetix 6000 IAM/AM modules.

### TIP

Use 2090-K6CK-D26M low-profile connector kits for wiring I/O and Feedback connections to the IOD connector.

### Converting 1394 SERCOS Discrete Inputs to Kinetix 6000 Drive

1394 Discrete Input Connectors Axis x	Description	Signal Name		Kinetix 6000 I/O Connector	Description	Signal Name
Pin-1	Hardware enable	ENABLE <sub>x</sub>	---	IOD-2	Hardware enable input	ENABLE
Pin-2	Home switch input	HOME <sub>x</sub>	---	IOD-5	Home switch input	HOME
Pin-5	Positive overtravel limit switch	POS_OTRAV <sub>x</sub>	---	IOD-8	Positive overtravel limit switch	OT+
Pin-6	Negative overtravel limit switch	NEG_OTRAV <sub>x</sub>	---	IOD-11	Negative overtravel limit switch	OT-
Pin-7	I/O Common	IO_COM <sub>x</sub>	---	IOD-3, 6, 9, 12	Common	+24V_COM
Customer-supplied 24V digital input power		IO_24V <sub>x</sub>	---	IOD-1, 4, 7, 10	24V digital input power	+24V_PWR
Customer-supplied 24V registration power		REG_24V <sub>x</sub>	---	IOD-13, 16	24V registration power	REG_24V
Pin-4	High speed registration 1 input	REG <sub>x</sub> _1	---	IOD-14	High speed registration 1 input	REG1
Pin-8	High speed registration 2 input	REG <sub>x</sub> _2	---	IOD-17	High speed registration 2 input	REG2
Pin-3	Registration common	REG <sub>x</sub> _COM <sub>x</sub>	---	IOD-15, 18	Common for registration	REG_COM

### Converting 1394 SERCOS Relay Outputs to Kinetix 6000 Drive

1394 Relay Output Connector	Description	Signal Name		Kinetix 6000 I/O Connector	Description	Signal Name
1	Drive OK relay.	DRIVE OK	---	CED-1	Contactor enable relay.	CONT EN-
2			---	CED-2		CONT EN+
3	Motor brake connections on axis module (axis 3).	OUTPUT 3	---	BC-5	Motor brake connections on AM module (axis 4).	MBRK+
4			---	BC-6		MBRK-
5	Motor brake connections on axis module (axis 2).	OUTPUT 2	---	BC-5	Motor brake connections on AM module (axis 3).	MBRK+
6			---	BC-6		MBRK-
7	Motor brake connections on axis module (axis 1).	OUTPUT 1	---	BC-5	Motor brake connections on AM module (axis 2).	MBRK+
8			---	BC-6		MBRK-
9	Motor brake connections on axis module (axis 0).	OUTPUT 0	---	BC-5	Motor brake connections on AM module (axis 1).	MBRK+
10			---	BC-6		MBRK-

### Converting 1394 SERCOS High-resolution Feedback to Kinetix 6000 Drive

1394 System Module Connector	MPL-Bxxx-M/S or 1326AB-Bxxx-M2L/S2L Motors	Signal		Kinetix 6000 MF Connector	MPL-Bxxx-M/S or 1326AB-Bxxx-M2L/S2L Motors	Signal
1	Sine differential input (+)	SINE+	---	MF-1	Sine differential input (+)	SINE+
2	Sine differential input (-)	SINE-	---	MF-2	Sine differential input (-)	SINE-
3	Cosine differential input (+)	COS+	---	MF-3	Cosine differential input (+)	COS+
4	Cosine differential input (-)	COS-	---	MF-4	Cosine differential input (-)	COS-
5	Common	ECOM	---	MF-6	Common	ECOMM
6	Encoder power (+9V)	EPWR_9VM	---	MF-7	Encoder power (+9V)	EPWR_9VM
8	Hiperface data channel	DATA+	---	MF-5	Hiperface data channel	DATA+
9	Hiperface data channel	DATA-	---	MF-10	Hiperface data channel	DATA-
12	Motor thermal switch input (+)	TS+	---	MF-11	Motor thermal switch <sup>(1)</sup>	TS
13	Motor thermal switch input (-)	TS-	---	Internal to cable	N/A	COMMON

<sup>(1)</sup> When using these high-resolution feedback motors, use 2090-K6CK-D15M low-profile connector kits.

### Converting 1394 SERCOS Resolver Feedback to Kinetix 6000 Drive

1394 System Module Connector	MPL-Bxxxx-R Motors	Signal		Kinetix 6000 MF Connector	MPL-Bxxxx-R 460V Motors	Signal
1	Sine differential input (+)	S2	---	MF-1	Sine differential input (+)	S2
2	Sine differential input (-)	S4	---	MF-2	Sine differential input (-)	S4
3	Cosine differential input (+)	S1	---	MF-3	Cosine differential input (+)	S1
4	Cosine differential input (-)	S3	---	MF-4	Cosine differential input (-)	S3
10	Resolver excitation	R1	---	MF-5	Resolver excitation	R1
11	Resolver excitation	R2	---	MF-10	Resolver excitation	R2
12	Motor thermal switch input (+)	TS+	---	MF-11	Motor thermal switch <sup>(1)</sup>	TS+
13	Motor thermal switch input (-)	TS-	---	MF-6		TS-

1394 System Module Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal		Kinetix 6000 MF Connector	1326AB-Bxxxx-21 or 1326AS-Bxxxx-21 Motors	Signal
1	Sine differential input (+)	S2	---	MF-1	Sine differential input (+)	S2
2	Sine differential input (-)	S4	---	MF-2	Sine differential input (-)	S4
3	Cosine differential input (+)	S1	---	MF-3	Cosine differential input (+)	S1
4	Cosine differential input (-)	S3	---	MF-4	Cosine differential input (-)	S3
10	Resolver excitation	R1	---	MF-5	Resolver excitation	R1
11	Resolver excitation	R2	---	MF-10	Resolver excitation	R2
12	Motor thermal switch input (+)	TS+	---	MF-16	Motor thermal switch <sup>(2)</sup>	TS+
13	Motor thermal switch input (-)	TS-	---	MF-17		TS-

<sup>(1)</sup> When using Bulletin MPL-Bxxxx-R (resolver-based) motors, use 2090-K6CK-D15M low-profile connector kits.

<sup>(2)</sup> When using Bulletin 1326AB or 1326AS (resolver-based) motors, use 2090-K6CK-D15MF low-profile connector kits.

## Power Specifications

This section provides power specifications for the 1394 and Kinetix 6000 drive modules.

### Power Specifications for 1394 Drives

#### 1394 System Module Power Specifications

Attribute	Value		
	1394x-SJT05 <sup>(1) (2)</sup>	1394x-SJT10 <sup>(1) (2)</sup>	1394x-SJT22 <sup>(1)</sup>
Rated AC input voltage	324...528V ac, 50/60 Hz 3-phase	324...528V ac, 50/60 Hz 3-phase	324...528V ac, 50/60 Hz 3-phase
AC input current (A <sub>rms</sub> )	6.5 A	13.0 A	28.6 A
Peak inrush current <sup>(2) (3) (4)</sup> (series A and B)	975 A	1300 A	697 A < 1 μs
Peak inrush current <sup>(3)</sup> (series C and D)	8A	8A	8A
Line loss ride through	20 ms	20 ms	20 ms
Nominal bus output voltage	530/680V dc	530/680V dc	530/680V dc
Continuous power output	4/5 kW	8/10 kW	17/22 kW
Peak power output <sup>(5)</sup>	28 kW	28 kW	136 kW
Efficiency	99%	99%	98%
Weight (series A and B)	11 kg (24.25 lb)	11 kg (24.25 lb)	12.7 kg (28.0 lb)
Weight (series C and D)	10.68 kg (23.5 lb)	10.68 kg (23.5 lb)	12.9 kg (28.5 lb)
Continuous current output (A <sub>dc</sub> )	7.36 A	14.73 A	33.8 A
Intermittent current output (A <sub>dc</sub> )	15.0 A	29.46 A	200 A
Capacitance (series A and B)	220 μF	330 μF	660 μF
Capacitance (series C and D)	220 μF	345 μF	660 μF
Inductance	1000 μH	750 μH	500 μH
Internal shunt resistor	200 W continuous, 40,000 W peak (two second maximum on time)		No internal shunt resistor

<sup>(1)</sup> The standard GMC and GMC Turbo system modules are identical except that the GMC Turbo (catalog number 1394x-SJTxx-T) offers a SLC backplane interface and 64K of memory with a 32-bit processor while the standard GMC (catalog number 1394x-SJTxx-C) offers 32K of program memory with a 16-bit processor without the SLC interface.

<sup>(2)</sup> The standard GMC (catalog number 1394C-SJTxx-L) is functionally the same as catalog number 1394x-SJTxx-C, except it only supports one axis and provides two auxiliary encoder inputs.

<sup>(3)</sup> 5 and 10 kW (series C and D) system modules and all 22 kW system modules are limited to four contactor cycles per minute. 5 and 10 kW (series A and B) system modules are limited to an average of four contactor cycles per hour.

<sup>(4)</sup>

$$\text{Peak inrush current for 5 and 10 kW systems (Series A and B)} = \frac{(\text{line voltage} \times 1.1 \times \sqrt{2})}{\sqrt{\left( \frac{L_{\text{system}}}{C_{\text{system}} + C_{\text{axes}}} \right)}}$$

Where: L = Inductance  
C = Capacitance

Peak inrush current for 22 kW (all series) and 5 and 10 kW (series C and D) systems is limited by an internal 80 ohm resistor. 8 A peak inrush current for all series C and D system modules will experience no more than a 40 A peak loss (less 1 ms).

<sup>(5)</sup> The Peak Power Output rating for 5 and 10 kW (series A and B) is based on the thermal limits of the modules. The Peak Power Output rating for 22 kW (all Series) and 5 and 10 kW (series C and D) is based on a current limit of 105% of two times the rated Continuous Current Output for 600 ms or the rated Peak Power Output for a duration equal to the equivalent watt-seconds.

### 1394 Axis Module Specifications

Attribute	Value				
	1394x-AM03	1394x-AM04	1394x-AM07	1394x-AM50 and 1394C-AM50-IH	1394x-AM75 and 1394C-AM75-IH
Speed regulation <sup>(1)</sup>	0...0.05% of base speed with 100% torque disturbance				
Static gain (rms A/mV) <sup>(1)</sup>	1.28	2.6	4.9	22.8	22.8
Peak current limit adjust	200%	200%	200%	143%	143%
Modulation frequency	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%	5 kHz ±10%
Drift	0.03 rpm/ °C	0.03 rpm/ °C	0.03 rpm/ °C	0.03 rpm/ °C	0.03 rpm/ °C
Nominal input voltage	530/680V dc	530/680V dc	530/680V dc	530/680V dc	530/680V dc
Continuous current (rms)	3.0 A	4.5 A	7.5 A	23.3 A	35.0 A
Peak current (rms - 1 second)	6.0 A	9.0 A	15.0 A	33.2 A	50.0 A
Continuous power out 360/460V nominal	1.6/2 kW	2.4/3 kW	4/5 kW	11.34/15.6 kW	17.8/23.8 kW
Efficiency	98%	98%	98%	98%	98%
Weight	5 kg (11.02 lb)	5 kg (11.02 lb)	5 kg (11.02 lb)	7 kg (15.44 lb) (1394-AM50 module)	7 kg (15.44 lb) (1394-AM75 module)
				6.73 kg (14.8 lb) (1394-AM50-IH module)	6.73 kg (14.8 lb) (1394-AM75-IH module)
Capacitance	110 µF	110 µF	220 µF	465 µF	660 µF

<sup>(1)</sup> When used with the controller in the (catalog number 1394x-SJTxx-x) system module.

### 1394 Fuse Specifications

1394 System Module Cat. No.	Series	Bussmann Fuse Description	Rating
1394-SJT05 systems	Series A and B	FRS-R-20 or equivalent	600V ac, 20 A
1394C-SJT05 systems	Series C and D	GTK-R-20 or equivalent	600V ac, 20 A
		LPJ-SP 20 or equivalent	600V ac, 20 A
1394-SJT10 systems	Series A and B	FRS-R-30 or equivalent	600V ac, 30 A
1394C-SJT10 systems	Series C and D	GTK-R-30 or equivalent	600V ac, 30 A
		LPJ-SP 30 or equivalent	600V ac, 30 A
1394x-SJT22 systems		FRS-R-35 or equivalent	600V ac, 35 A
		LPS-RK-SP 40 or equivalent	600V ac, 40 A
		LPJ-SP 45 or equivalent	600V ac, 45 A

**1394 Contactor (M1) Specifications**

1394 System Module Cat. No.	Series	Allen-Bradley Contactor Description	Rating
1394-SJT05 and 1394-SJT10	Series A and B	100-C43x10 (ac coil) 100-C43Zx10 (dc coil)	600V ac, 43 A
1394C-SJT05 and 1394C-SJT10	Series C and D	100-C23x10 (ac coil) 100-C23Zx10 (dc coil)	600V ac, 23 A
1394x-SJT22		100-C37x10 (ac coil) 100-C37Zx10 (dc coil)	600V ac, 37 A

**IMPORTANT**

Use the power dissipation figures shown below to calculate cumulative system heat dissipation to ensure that the ambient temperature inside the enclosure does not exceed 50 °C (122 °F). To calculate total power dissipation, add the dissipation of the system module to the dissipation of the axis modules.

**1394 System Power Dissipation Specifications**

1394 Drive Module Cat. No.	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
System Modules					
1394x-SJT05-x	66	70	73	77	80
1394x-SJT10-x	70	77	84	81	98
1394x-SJT22-x	100	150	200	250	300
Axis Modules					
1394x-AM03	24	30	36	42	48
1394x-AM04	27	36	45	54	63
1394x-AM07	33	48	63	78	93
1394-AM50 <sup>(1)</sup> and 1394-AM50-IH <sup>(2)</sup>	56	95	139	183	227
1394-AM75 <sup>(1)</sup> and 1394-AM75-IH <sup>(2)</sup>	85	145	212	279	346
1394-AM50 (inside the cabinet) <sup>(1)</sup>	18	18	18	18	18
1394-AM50 (outside the cabinet) <sup>(1)</sup>	38	77	138	165	209
1394-AM75 (inside the cabinet) <sup>(1)</sup>	18	18	18	18	18
1394-AM75 (outside the cabinet) <sup>(1)</sup>	67	127	194	261	324

<sup>(1)</sup> The 1394-AM50 and 1394-AM75 axis modules are designed to mount with the rear heat sink extended outside the customer-supplied enclosure. If the modules are mounted entirely inside the customer-supplied enclosure, the full power dissipation is inside the cabinet (the sum of the inside/outside columns).

<sup>(2)</sup> The 1394-AM50-IH and 1394-AM75-IH axis modules are designed to mount entirely inside the customer-supplied enclosure.

## Power Specifications for Kinetix 6000 Drives

### IAM (460V) Modules Power Specifications

Attribute	Value				
	2094-BC01-MP5-S	2094-BC01-M01-S	2094-BC02-M02-S	2094-BC04-M03-S	2094-BC07-M05-S
AC input voltage	324...528V rms three-phase (360...480V nom)				
AC input frequency	47...63 Hz				
Main ac input current <sup>(1)</sup> Nom (rms) Max inrush (0-pk)	10 A 10 A	24 A 20 A	44 A 34 A	71 A 56 A	
DC input voltage (common bus follower)	458...747V dc				
DC input current (common bus follower)	10 A	24 A	43 A	71 A	
Control power ac input voltage	95...264V rms single-phase (230V nom)				
Control power ac input current Nom (@ 220/230V ac) rms Nom (@ 110/115V ac) rms Max inrush (0-pk)	3 A 6 A 25 A				
Nominal bus output voltage	650V dc				
Line loss ride through	20 ms				
Continuous output current to bus ( $A_{dc}$ )	10 A	24 A	43 A	71 A	
Intermittent output current to bus ( $A_{dc}$ ) <sup>(2)</sup>	20 A	48 A	86 A	142 A	
Bus overvoltage	825V dc				
Bus undervoltage	275V dc				
Internal shunt Continuous power Peak power	50 W 5600 W		200 W 22,300 W		
Internal shunt resistor	115 $\Omega$		28.75 $\Omega$		
Shunt on	805V dc				
Shunt off	755V dc				
Continuous power output to bus	6 kW	15 kW	27.6 kW	45 kW	
Peak power output	12 kW	30 kW	55.2 kW	90 kW	
Efficiency	95%				
Converter inductance	250 $\mu$ H		125 $\mu$ H	75 $\mu$ H	
Converter capacitance	110 $\mu$ F	220 $\mu$ F	940 $\mu$ F	1410 $\mu$ F	

<sup>(1)</sup> All 2094-xCxx integrated axis modules are limited to 2 contactor cycles per minute (with up to 4 axis modules), or 1 contactor cycle per minute (with 5 to 8 axis modules).

<sup>(2)</sup> Intermittent output current duration equals 250 ms.



## Control Power Current Requirements

Modules on Power Rail	110/115V ac Input A	220/230V ac Input A	Input VA VA	Modules on Power Rail	110/115V ac Input A	220/230V ac Input A	Input VA VA
IAM only	0.75	0.35	150	IAM, 4 AM	3.75	1.70	450
IAM, 1 AM	1.50	0.70	200	IAM, 5 AM	4.50	2.0	550
IAM, 2 AM	2.25	1.0	275	IAM, 6 AM	5.25	2.40	650
IAM, 3 AM	3.0	1.35	350	IAM, 7 AM	6.0	3.0	750

These specifications apply to the axis module specified in the column heading by catalog number and the same axis module (inverter section) that resides within an integrated axis module.

## AM (inverter) 460V Module Power Specifications

Attribute	Value				
	2094-BMP5-S (2094-BC01-MP5-S)	2094-BM01-S (2094-BC01-M01-S)	2094-BM02-S (2094-BC02-M02-S)	2094-BM03-S (2094-BC04-M03-S)	2094-BM05-S (2094-BC07-M05-S)
Bandwidth <sup>(1)</sup> Velocity loop Current loop	500 Hz 1300 Hz				
PWM frequency	8 kHz		4 kHz		
Input voltage (nom)	650V dc				
Continuous current (rms)	2.8 A	6.1 A	10.3 A	21.2 A	34.6 A
Continuous current (sine) 0-pk	4.0 A	8.6 A	14.6 A	30.0 A	48.9 A
Peak current (rms) <sup>(2)</sup>	4.2 A	9.2 A	15.5 A	31.8 A	51.9 A
Peak current (0-pk) <sup>(2)</sup>	5.9 A	12.9 A	21.8 A	45.0 A	73.4 A
Continuous power out (nom)	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22.0 kW
Internal shunt Continuous power Peak power	50 W 5600 W			200 W 22,300 W	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V dc				
Shunt off	755V dc				
Efficiency	97%				
Capacitance	75 μF	150 μF	270 μF	840 μF	1175 μF
Capacitive energy absorption	10 J	19 J	35 J	108 J	152 J

<sup>(1)</sup> Bandwidth values vary based on tuning parameters and mechanical components.

<sup>(2)</sup> Peak current duration equals 2.5 s.

Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with IAM modules (2094-BCxx-Mxx-S) when a LIM module is not used.

**IMPORTANT**

LIM modules (catalog numbers 2094-ALxxS, 2094-BLxxS, and 2094-XL75S-Cx) provide branch circuit protection to the IAM module. Follow all applicable NEC and local codes.

**Kinetix 6000 Fuse Specifications**

Kinetix 6000 IAM Module Cat. No.	VAC Input Power			Control Input Power		DC Common Bus Fuse	
	Bussmann Fuse	Allen-Bradley Circuit Breaker <sup>(1)</sup>		Bussmann Fuse	Allen-Bradley Circuit Breaker <sup>(1)</sup>	Bussmann Fuse	Ferraz Shawmut Fuse
2094-AC05-MP5-S	KTK-R-20 (20 A)	1492-CB3H300	140M-F8E-C16	FNQ-R-10 (10 A)	1492-CB2H060	N/A	A50P20-1
2094-AC05-M01-S							
2094-AC09-M02-S	KTK-R-30 (30 A)	1492-CB3H400	140M-F8E-C20			FWH-35B	A50P35-4
2094-AC16-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50		1492-SP2D200	FWH-60B	A50P60-4
2094-AC32-M05-S	LPJ-80SP (80 A)	N/A	140U-H6C3-C90			FWH-125B	A50P125-4
2094-BC01-MP5-S	KTK-R-20 (20 A)	1492-CB3H300	140M-F8E-C32		1492-CB2H060	N/A	A100P20-1
2094-BC01-M01-S							
2094-BC02-M02-S	KTK-R-30 (30 A)	1492-CB3H400	140M-F8E-C45			FWJ-40A	A100P40-1
2094-BC04-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWJ-70A	A100P70-1
2094-BC07-M05-S	LPJ-80SP (80 A)		140U-H6C3-C90			FWJ-125A	A100P125-1

<sup>(1)</sup> When using Bulletin 1492 circuit protection devices, the maximum short circuit current available from the source is limited to 5000 A.

**ATTENTION**


Bulletin 1492 and 140M circuit breakers should not be used on the output of an ac drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not allow it to operate properly. As a result, damage to the device occurs.

**Kinetix 6000 Contactor Ratings**

460V IAM Module Cat. No.	Allen-Bradley Contactor Description <sup>(1)</sup>	Rating
2094-BC01-MP5-S	100-C23x10 (ac coil) 100-C23Zx10 (dc coil)	600V ac, 23 A
2094-BC01-M01-S		
2094-BC02-M02-S	100-C37x10 (ac coil) 100-C37Zx10 (dc coil)	600V ac, 37 A
2094-BC04-M03-S	100-C60x10 (ac coil) 100-C60Zx10 (dc coil)	600V ac, 60 A
2094-BC07-M05-S	100-C72x10 (ac coil) 100-C72Zx10 (dc coil)	600V ac, 72 A

<sup>(1)</sup> Recommended Allen-Bradley contactors for IAM modules for systems without a LIM module.

### Power Dissipation Specifications

Kinetix 6000 Drive Module Cat. No.	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
Integrated Axis Module (IAM Converter) <sup>(1)</sup>					
2094-BC01-MP5-S	15	20	25	30	35
2094-BC01-M01-S					
2094-BC02-M02-S	20	30	40	50	60
2094-BC04-M03-S	22	43	65	86	108
2094-BC07-M05-S	44	77	111	144	177
Integrated Axis Module (IAM Inverter) or Axis Module (AM) <sup>(1)</sup>					
2094-BC01-MP5-S or 2094-BMP5-S	75.7	80.9	86	92	98
2094-BC01-M01-S or 2094-BM01-S	95	120	145	170	195
2094-BC02-M02-S or 2094-BM02-S	98	126	154	182	210
2094-BC04-M03-S or 2094-BM03-S	95	132	171	212	256
2094-BC07-M05-S or 2094-BM05-S	118	182	251	326	406
Shunt Module (SM)					
2094-BSP2	68	121	174	227	280

<sup>(1)</sup> Internal shunt power is not included in the calculations and must be added based on utilization.

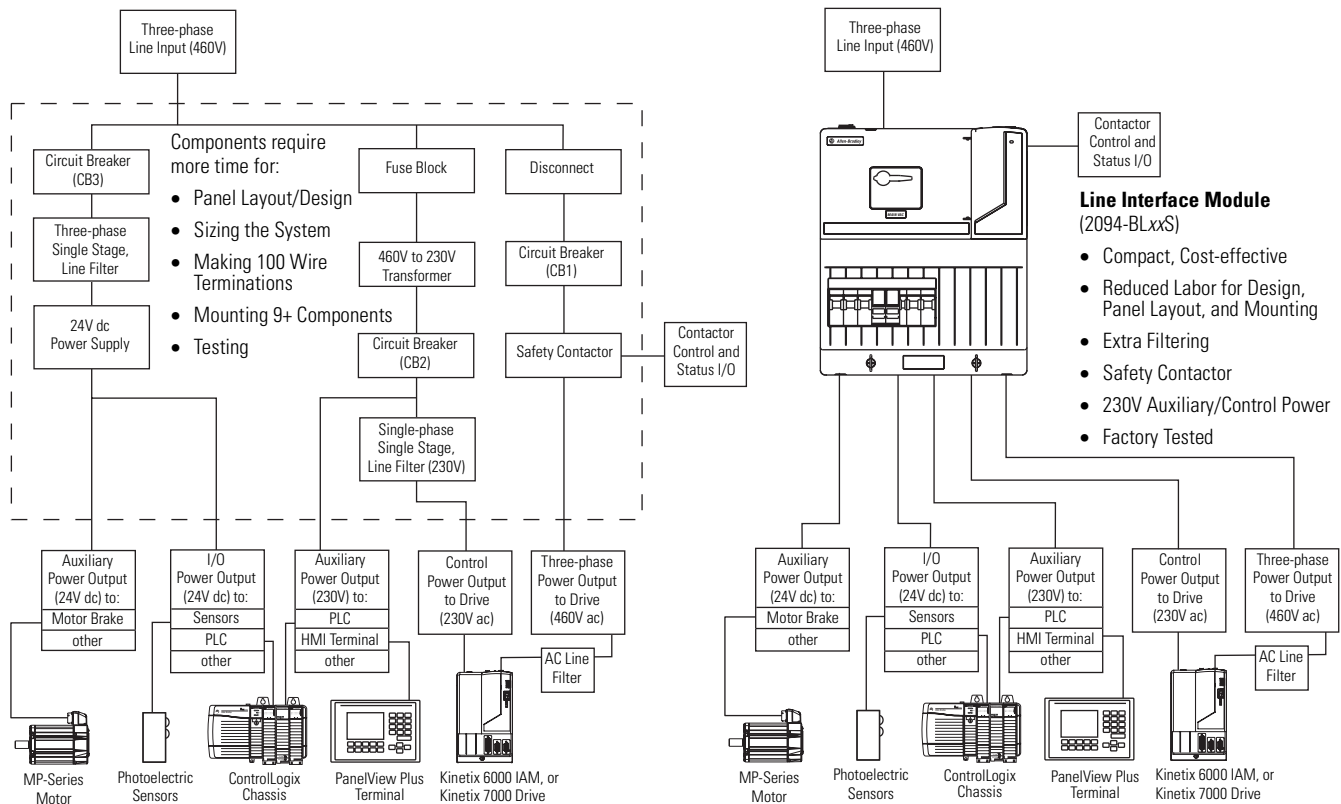
## Drive Accessories

Consider these power components when planning your 1394 to Kinetix 6000 drive conversion.

### Line Interface Modules

The Bulletin 2094 Line Interface Module (LIM) is designed to replace many of the common input power components required for your servo drive system. Using the LIM module saves panel space and reduces the amount of wiring when compared with individual components mounted separately. In this example, the 2094-BLxxS module is compared to a similar configuration of discrete components. Auxiliary and control power (230V) is developed from the LIM module three-phase input power.

#### Comparing the 2094-BLxxS LIM Module with Discrete Components



For more information on selecting a LIM module for your 1394 drive conversion, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#).

## AC Line Filters

An ac line filter is required for meeting CE requirements.

### 1394 AC Line Filters

<b>1394 System Module Cat. No.</b>	<b>AC Line Filter Cat. No.</b>
1394x-SJT05	2090-UXLF-HV323
1394x-SJT10	2090-XXLF-X330B
1394x-SJT22	2090-XXLF-375

Line filters used with your 1394 drive may perform adequately with your Kinetix 6000 conversion drive to suppress electrical noise, however, Kinetix 6000 drives were tested for CE compliance using the Bulletin 2090 filters as listed in this table.

### Kinetix 6000 AC Line Filters

<b>Kinetix 6000 IAM Cat. No.</b>	<b>AC Line Filter Cat. No.</b>
2094-BC01-MP5-S	2090-XXLF-X330B
2094-BC01-M01-S	
2094-BC02-M02-S	
2094-BC04-M03-S	2090-XXLF-375B
2094-BC07-M05-S	2090-XXLF-3100

For more information on selecting an ac line filter for your 1394 drive conversion, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#).

## External Shunt Modules

Select one of these Bulletin 1394 passive shunt modules when your Kinetix 6000 drive application exceeds the capacity of the internal (IAM/AM module) shunt resistor.

### 1394 External Shunt Modules

1394 System Module <sup>(1)</sup> Cat. No.	Shunt Module Cat. No.
1394x-SJT05 and 1394x-SJT10	1394-SR10A
1394x-SJT22	1394-SR9A
	1394-SR9AF
	1394-SR36A
	1394-SR36AF

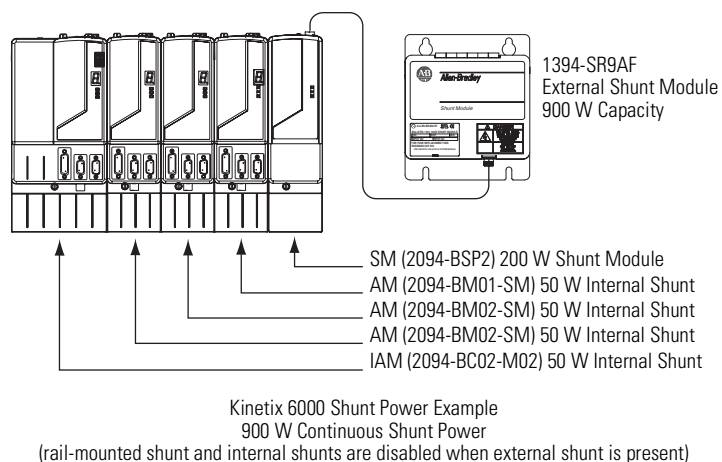
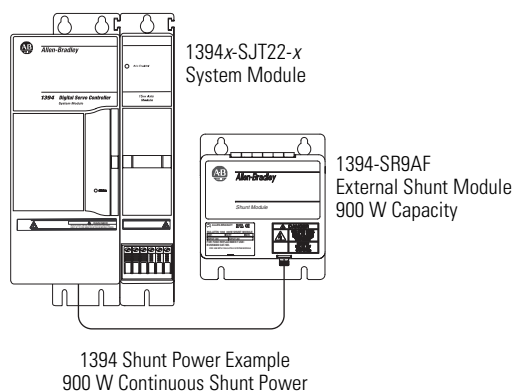
<sup>(1)</sup> The 1394x-SJT05 and 1394x-SJT10 system modules contain a 200 W internal shunt resistor. The 1394x-SJT22 system module requires an external shunt.

### Kinetix 6000 External Shunt Modules

Kinetix 6000 IAM Module Cat. No.	Shunt Module <sup>(1)</sup> Cat. No.
2094-BCxx-Mxx-S	1394-SR9A
	1394-SR9AF
	1394-SR36A
	1394-SR36AF

<sup>(1)</sup> These external passive shunt modules wire to the Kinetix 6000 (rail-mounted) shunt module (catalog number 2094-BSP2).

### Shunt Power Example



For more information on selecting an external shunt module for your 1394 drive conversion, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#).

## Motor/Drive Cable Compatibility

This section provides motor/drive cable compatibility information for your 1394 drive conversion.

### 1326AB Motors

Motor Cat. No.	Drive Compatibility	Feedback Type	Motor Feedback Cables
1326AB-Bxxxx-M2L/S2L	2094-BCxx-Mxx-S or 2094-BMxx-S	Multi-turn High Resolution Absolute or Single-turn High Resolution Encoder Feedback	2090-XXNFMP-Sxx (flying lead) <sup>(1)</sup> or 2090-UXNFBMP-Sxx (premolded connector)
	1394C-SJTxx-D		2090-CDNFDMP-Sxx <sup>(1)</sup>
1326AB-Bxxxx-21	2094-BCxx-Mxx-S or 2094-BMxx-S 1394x-SJTxx-A 1394x-SJTxx-C 1394C-SJTxx-D 1394C-SJTxx-L 1394x-SJTxx-T	Resolver	1326-CCUx-x-xxx <sup>(2)</sup>

<sup>(1)</sup> Use low-profile connector kit (catalog number 2090-K6CK-D15M) or panel-mounted breakout components on drive end. Refer to Kinetix Motion Control Selection Guide, publication [GMC-SG001](#), for more information.

<sup>(2)</sup> Use low-profile connector kit (catalog number 2090-K6CK-D15MF) on drive end. Refer to Kinetix Motion Control Selection Guide, publication [GMC-SG001](#), for more information.

1326AB (460V) M2L/S2L Motors	Motor Power Cables
1326AB-B410G, 1326AB-B410J, 1326AB-B420E, 1326AB-B420H, 1326AB-B430E, 1326AB-B430G	2090-XXNPMP-16Sxx
1326AB-B515E, 1326AB-B515G, 1326AB-B520E, 1326AB-B520F, and 1326AB-B530E	
1326AB-B720E	2090-XXNPMP-14Sxx
1326AB-B720F, 1326AB-B730E, 1326AB-B740C, and 1326AB-B740E	2090-XXNPMP-10Sxx

1326AB (460V) Resolver Motors	Motor Power Cables
1326AB-B410G, 1326AB-B410J, 1326AB-B420E, 1326AB-B420H, 1326AB-B430E, 1326AB-B430G	1326-CPB1x-x-xxx
1326AB-B515E, 1326AB-B515G, 1326AB-B520E, 1326AB-B520F, and 1326AB-B530E	
1326AB-B720E, 1326AB-B720F, 1326AB-B730E, 1326AB-B740C, and 1326AB-B740E	1326-CPC1x-x-xxx

1326AB (460V) Motors	Motor Brake Cables
All 1326AB-Bxxxx-M2L/S2L motors	2090-UXNBMP-18Sxx
All 1326AB-Bxxxx-21 motors	Separate brake cable not required. Brake wires are included with power cable.

**1326AS Motors**

Motor Cat. No.	Drive Compatibility	Feedback Type	Motor Feedback Cables
1326AS-Bxxxx-21	2094-BCxx-Mxx-S or 2094-BMxx-S 1394x-SJTxx-A 1394x-SJTxx-C 1394C-SJTxx-D 1394C-SJTxx-L 1394x-SJTxx-T	Resolver	1326-CCUx-x-xxx <sup>(1)</sup>

<sup>(1)</sup> Use low-profile connector kit (catalog number 2090-K6CK-D15MF) on drive end. Refer to Kinetix Motion Control Selection Guide, publication [GMC-SG001](#), for more information.

<b>1326AS (460V) Resolver Motors</b>	<b>Motor Power Cables</b>
1326AS-B310H and 1326AS-B330H	1326-CPB1x-x-xxx
1326AS-B420G, 1326AS-B440G, and 1326AS-B460F	
1326AS-B630F, 1326AS-B660E, and 1326AS-B690E	1326-CPC1x-x-xxx
1326AS-B840E and 1326AS-B860C	

<b>1326AS (460V) Motors</b>	<b>Motor Brake Cables</b>
All 1326AS-Bxxxx-21 motors	Separate brake cable not required. Brake wires are included with power cable.



**MP-Series Low Inertia Motors**

Motor Cat. No.	Drive Compatibility	Feedback Type	Motor Feedback Cables
MPL-BxxxxM/S	2094-BCxx-Mxx-S or 2094-BMxx-S	Multi-turn High Resolution Absolute or Single-turn High Resolution Encoder Feedback	2090-XXNFMF-Sxx (flying lead) <sup>(1)</sup> or 2090-UXNFBMP-Sxx (premolded connector)
	1394C-SJTxx-D		2090-CDNFDMP-Sxx (flying lead) <sup>(1)</sup>
MPL-BxxxxV/E	2094-BCxx-Mxx-S or 2094-BMxx-S		2090-XXNFMF-Sxx (flying lead) <sup>(1)</sup>
MPL-BxxxxR	2094-BCxx-Mxx-S or 2094-BMxx-S 1394x-SJTxx-A 1394x-SJTxx-C 1394C-SJTxx-D 1394C-SJTxx-L 1394x-SJTxx-T	Resolver	2090-CDNFDMP-Sxx (flying lead) <sup>(1)</sup>

<sup>(1)</sup> Use low-profile connector kit (catalog number 2090-K6CK-D15M) or panel-mounted breakout components on drive end. Refer to Kinetix Motion Control Selection Guide, publication [GMC-SG001](#), for more information.

MP-Series (460V) Low Inertia Motors	Motor Power Cables
MPL-B15xx and MPL-B2xx	2090-XXNPMP-16Sxx
MPL-B310P, MPL-B320P, and MPL-B330P	2090-XXNPMP-16Sxx
MPL-B420P and MPL-B430P	
MPL-B4520P, MPL-B4530F, MPL-B4530K, MPL-B4540F, MPL-B4560F, and MPL-B520K	
MPL-B540K, MPL-B560F, and MPL-B580F	2090-XXNPMP-14Sxx
MPL-B580J	2090-XXNPMP-10Sxx
MPL-B640F, MPL-B660F, MPL-B680D, and MPL-B680F	2090-XXNPMP-8Sxx
MPL-B860D, MPL-B880C, and MPL-B880D	
MPL-B960B, MPL-B960C, MPL-B980B, and MPL-B980C	
MPL-B960D and MPL-B980D	2090-MCNPMP-6Sxx

MP-Series (460V) Low Inertia Motors	Motor Brake Cables
All MPL-Bxxxx motors (that require a brake cable)	2090-UXNBMP-18Sxx

## 1394 Drive/Motor System Combinations

This section provides drive/motor system combination data for your existing 1394 drive/motor combination.

These combinations are with 1394C-SJTxx-D (SERCOS) drives and MPL-BxxxxM/S motors.

### IMPORTANT

To achieve the performance specifications in the table below, your 1394C-SJTxx-D system module must have firmware revision 1.058 or later.

### 1394 SERCOS Drives/Bulletin MPL (460V) Motors Performance Specifications

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
MPL-B310P	5000	2.40	1.58 (14)	7.1	3.60 (32)	0.72	1394C-AM03
MPL-B320P	5000	4.24	2.77 (24)	8.5	5.0 (44)	1.3	1394C-AM03
		4.50	2.94 (26)	12.7	7.10 (63)		1394C-AM04
				13	7.30 (65)		1394C-AM07
MPL-B330P	5000	4.24	2.91 (26)	8.5	5.62 (50)	1.7	1394C-AM03
		6.10	4.18 (37)	12.7	8.40 (74)		1394C-AM04
				17	11.1 (98)		1394C-AM07
MPL-B420P	5000	4.24	3.14 (28)	8.5	5.62 (50)	1.9	1394C-AM03
		6.40	4.74 (42)	12.7	8.39 (74)		1394C-AM04
				21.2	12.7 (112)		1394C-AM07
				23	13.5 (119)		1394C-AM50
MPL-B430P	5000	4.24	3.02 (27)	8.5	5.90 (52)	2.4	1394C-AM03
		6.40	4.56 (40)	12.7	8.70 (77)		1394C-AM04
		9.20	6.55 (58)	21.2	14.0 (124)		1394C-AM07
				31	19.8 (175)		1394C-AM50
MPL-B4520P	5000	4.24	3.04 (27)	8.50	4.78 (42)	2.5	1394C-AM03
		6.40	4.59 (41)	12.70	7.14 (63)		1394C-AM04
		8.50	6.10 (54)	21.00	11.8 (104)		1394C-AM07
				24.00	13.5 (119)		1394C-AM50
MPL-B4530F	3000	4.24	4.90 (44)	8.5	9.20 (81)	2.2	1394C-AM03
		6.40	7.40 (65)	12.7	13.3 (118)		1394C-AM04
		7.10	8.36 (74)	21.0	20.3 (180)		1394C-AM07
MPL-B4530K	4000	4.24	3.22 (28)	8.5	6.20 (55)	2.6	1394C-AM03
		6.40	4.80 (42)	12.7	9.10 (80)		1394C-AM04
		10.60	8.06 (71)	21.2	14.6 (129)		1394C-AM07
		11.00	8.36 (74)	31.0	20.3 (180)		1394C-AM50

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
MPL-B4540F	3000	4.24	4.75 (42)	8.5	9.30 (82)	3.0	1394C-AM03
		6.40	7.17 (63)	12.7	13.8 (122)		1394C-AM04
		9.10	10.20 (90)	21.2	22.4 (198)		1394C-AM07
				26.0	27.1 (240)		1394C-AM50
MPL-B4560F	3000	10.6	12.6 (111)	21.2	22.7 (200)	3.2	1394C-AM07
MPL-B520K	4000	10.6	9.86 (87)	21.2	16.5 (146)	3.5	1394C-AM07
		11.5	10.7 (95)	33.0	23.2 (205)		1394C-AM50
MPL-B540D	2000	10.5	19.4 (172)	21.2	37.9 (335)	3.4	1394C-AM07
MPL-B540K	4000	10.6	10.3 (89)	21.2	17.2 (152)	5.4	1394C-AM07
		20.5	19.4 (172)	46.9	38.0 (336)		1394C-AM50
				60.0	48.6 (430)		1394C-AM75
MPL-B560F	3000	20.6	26.8 (237)	46.9	51.2 (453)	5.5	1394C-AM50
				68.0	67.8 (600)		1394C-AM75
MPL-B580F	3000	26.0	34.0 (301)	46.9	52.8 (467)	7.16	1394C-AM50
				70.7	72.4 (640)		1394C-AM75
MPL-B580J	3800	32.0	34.0 (301)	46.9	45.6 (403)	7.9	1394C-AM50
				70.7	65.2 (577)		1394C-AM75
MPL-B640F	3000	32.1	36.7 (325)	46.9	52.1 (462)	6.11	1394C-AM50
				65.0	72.3 (640)		1394C-AM75
MPL-B660F	3000	33.0	41.1 (364)	46.9	56.2 (497)	6.15	1394C-AM50
		38.5	48.0 (425)	70.7	84.7 (750)		1394C-AM75
MPL-B680D	2000	33.0	60.9 (539)	46.9	82.4 (729)	9.3	1394C-AM50
		34.0	62.8 (556)	70.7	120 (1062)		1394C-AM75
MPL-B680F	3000	33.0	41.2 (365)	46.9	56.2 (497)	7.5	1394C-AM50
		48.0	60.0 (531)	70.7	84.7 (750)		1394C-AM75
MPL-B860D	2000	45.3	79.6 (704)	70.7	116 (1028)	12.5	1394C-AM75
MPL-B880C	1500	45.3	104 (920)	70.7	152 (1344)	12.6	1394C-AM75
MPL-B960B	1200	42.5	130 (1150)	70.7	195 (1724)	12.7	1394C-AM75
MPL-B960C	1500	41.5	102 (902)	70.7	142 (1256)	13.5	1394C-AM75
MPL-B980B	1000	40.0	163 (1441)	70.7	229 (2025)	15.2	1394C-AM75
MPL-B980C	1500	47.5	104 (920)	70.7	151 (1335)	13.5	1394C-AM75

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

These combinations are with 1394x-SJTxx-A, 1394x-SJTxx-C, 1394x-SJTxx-L, and 1394x-SJTxx-T, non-SERCOS drives, and MPL-BxxxxR (resolver) motors.

### 1394 Non-SERCOS Drives/Bulletin MPL (460V) Motors Performance Specifications

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
MPL-B310P	5000	2.40	1.58 (14)	4.30	2.48 (21.95)	0.72	1394x-AM03
MPL-B320P	5000	4.24	2.77 (24.52)	7.10	4.52 (40)	1.3	1394x-AM03
		4.50	2.94 (26.02)				1394x-AM04
MPL-B330P	5000	4.24	2.91 (25.71)	8.50	5.62 (49.77)	1.7	1394x-AM03
		6.10	4.18 (36.99)	9.90	6.55 (57.97)		1394x-AM04
MPL-B420P	5000	4.24	3.14 (27.79)	8.50	5.62 (49.71)	1.9	1394x-AM03
		6.40	4.74 (41.95)	12.70	8.39 (74.27)		1394x-AM04
				13.00	8.59 (76.02)		1394x-AM07
MPL-B430P	5000	4.24	3.02 (26.72)	8.50	5.90 (52.22)	2.4	1394x-AM03
		6.40	4.56 (40.33)	12.70	8.82 (78.02)		1394x-AM04
		9.20	6.55 (57.97)	17.00	11.80 (104.43)		1394x-AM07
MPL-B4520P	5000	4.24	3.04 (26.93)	8.50	4.78 (42.31)	2.5	1394x-AM03
		6.40	4.59 (40.65)	12.70	7.14 (63.22)		1394x-AM04
		8.50	6.10 (53.99)	21.00	11.81 (104.54)		1394x-AM07
				24.00	13.50 (119.48)		1394x-AM50
MPL-B4530F	3000	4.24	4.99 (44.18)	8.50	8.32 (73.64)	2.2	1394x-AM03
		6.40	7.54 (66.69)	12.70	12.43 (110.03)		1394x-AM04
		7.10	8.36 (73.99)	19.00	18.60 (164.61)		1394x-AM07
MPL-B4530K	4000	4.24	3.22 (28.52)	8.50	5.86 (51.82)	2.6	1394x-AM03
		6.40	4.86 (43.05)	12.70	8.75 (77.43)		1394x-AM04
		10.60	8.06 (71.30)	21.00	14.47 (128.03)		1394x-AM07
		11.00	8.36 (73.99)	27.00	18.60 (164.61)		1394x-AM50
MPL-B4540F	3000	4.24	4.75 (42.06)	8.50	8.76 (77.51)	3.0	1394x-AM03
		6.40	7.17 (63.49)	12.70	13.09 (115.82)		1394x-AM04
		9.10	10.20 (90.27)	21.00	21.64 (191.51)		1394x-AM07
				23.00	23.70 (209.75)		1394x-AM50
MPL-B580F	3000	26.0	34.0 (301)	70.7	72.4 (640)	7.16	1394x-AM75

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

### 1394 Drives/1326AB (460V) Motors Performance Specifications

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A rms	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A rms	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
1326AB-B410G	5000	2.45	2.7 (24)	6.0	6.6 (58)	1.0	1394x-AM03
				7.32	8.1 (72)		1394x-AM04
1326AB-B410J	7250	3.0	2.3 (21)	6.0	4.7 (42)	1.4	1394x-AM03
		3.48	2.7 (24)	9.0	7.0 (62)		1394x-AM04
				10.4	8.1 (72)		1394x-AM07
1326AB-B420E	3000	2.84	5.0 (44)	6.0	10.6 (94)	1.1	1394x-AM03
				8.0	14.9 (132)		1394x-AM04
1326AB-B420H	6000	3.0	2.8 (25)	6.0	5.6 (50)	2.2	1394x-AM03
		4.5	4.2 (37)	9.0	8.4 (74)		1394x-AM04
		5.46	5.1 (45)	15.0	14.0 (124)		1394x-AM07
1326AB-B430E	3000	3.0	5.1 (45)	6.0	10.1 (89)	1.4	1394x-AM03
		3.9	6.6 (58)	9.0	15.2 (135)		1394x-AM04
				11.6	19.7 (174)		1394x-AM07
1326AB-B430G	5000	4.5	5.2 (46)	9.0	10.3 (92)	2.3	1394x-AM04
		5.6	6.4 (57)	15.0	17.2 (153)		1394x-AM07
1326AB-B515E	3000	4.5	7.7 (68)	9.0	15.4 (136)	2.3	1394x-AM04
		6.1	10.4 (92)	15.0	25.6 (226)		1394x-AM07
				18.3	31.2 (276)		1394x-AM50
1326AB-B515G	5000	7.5	7.9 (70)	15	15.8 (140)	2.9	1394x-AM07
		9.5	10.4 (92)	28.5	31.2 (276)		1394x-AM50
1326AB-B520E	3000	4.5	8.8 (78)	9.0	17.7 (157)	2.9	1394x-AM04
		6.7	13.0 (115)	15.0	29.4 (260)		1394x-AM07
				20.1	39.0 (345)		1394x-AM50
1326AB-B520F	3500	7.5	11.2 (99)	15.0	22.4 (198)	2.9	1394x-AM07
		8.8	13.1 (116)	26.4	39.3 (348)		1394x-AM50
1326AB-B530E	3000	7.5	14.2 (126)	15.0	28.4 (251)	4.2	1394x-AM07
		9.5	18.0 (160)	28.5	54.2 (480)		1394x-AM50
1326AB-B720E	3500	17.5	30.9 (273)	33.2	58.5 (518)	6.8	1394x-AM50
				50.0	88.1 (780)		1394x-AM75
1326AB-B720F	5000	27.5	31.8 (282)	33.2	38 (336)	11.7	1394x-AM50
				50	56 (495)		1394x-AM75
1326AB-B730E	3350	22.8	39.0 (345)	33.2	56.8 (502)	9.6	1394x-AM50
				50.0	85.4 (756)		1394x-AM75

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A rms	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A rms	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
1326AB-B740C	2200	20.9	53.0 (469)	33.2	84.2 (745)	8.7	1394x-AM50
				50.0	126.8 (1122)		1394x-AM75
1326AB-B740E	3400	23.33	37.0 (327)	33.2	52.6 (465)	12.7	1394x-AM50
		32.0	50.8 (450)	50.0	79.4 (702)		1394x-AM75

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

### 1394 Drives/1326AS (460V) Motors Performance Specifications

Motor Cat. No.	Maximum Speed rpm	System Continuous Stall Current Amps (rms)	System Continuous Torque Nm (lb-in)	System Peak Stall Current Amps (rms)	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	1394 Axis Module Cat. No.
1326AS-B310H	6200	0.8	0.7 (6.1)	2.4	2.1 (18)	0.3	1394x-AM03
1326AS-B330H	6500	2.1	2.1 (18)	6.0	5.6 (50)	0.9	1394x-AM03
							1394x-AM04
1326AS-B420G	5250	2.6	3.2 (28)	6.0	7.3 (65)	1.2	1394x-AM03
				7.8	9.6 (84)		1394x-AM04
							1394x-AM07
1326AS-B440G	5250	4.5	5.3 (47)	9.0	10.5 (93)	2.0	1394x-AM04
		5.4	6.4 (56)	15.0	17.6 (156)		1394x-AM07
				16.2	19.0 (168)		1394x-AM50
1326AS-B460F	4300	4.5	6.6 (58)	9.0	13.1 (116)	2.8	1394x-AM04
		6.2	9.0 (80)	15.0	21.9 (194)		1394x-AM07
				18.6	27.1 (240)		1394x-AM50
1326AS-B630F	4500	7.5	10.3 (91)	15.0	20.6 (182)	2.4	1394x-AM07
		7.8	10.7 (95)	18.5	25.4 (225)		1394x-AM50
1326AS-B660E	3000	7.5	13.7 (121)	15.0	27.3 (242)	3.4	1394x-AM07
		11.8	21.5 (190)	29.8	54.2 (480)		1394x-AM50
1326AS-B690E	3000	19.0	36.4 (322)	33.2	63.6 (563)	5.0	1394x-AM50
				41.3	79.1 (700)		1394x-AM75
1326AS-B840E	3000	21.2	37.6 (333)	33.2	59.0 (522)	4.7	1394x-AM50
				39.5	70.0 (620)		1394x-AM75
1326AS-B860C	2000	17.6	49.3 (436)	33.2	93.0 (823)	6.0	1394x-AM50
				44.4	124.0 (1100)		1394x-AM75

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

## Kinetix 6000 Drive/Motor System Combinations

This section provides drive/motor system combinations for your conversion to Kinetix 6000 drives. For torque/speed curves and combinations with other MP-Series, TL-Series, or F-Series motors, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#) or the Motion Analyzer/Motion Selector CD, publication PST-SG003.

### Kinetix 6000 Drives/Bulletin MPL (460V) Motors Performance Specifications

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	Kinetix 6000 460V Drives Cat. No.
MPL-B1510V	8000	0.95	0.26 (2.3)	3.10	0.77 (6.8)	0.16	2094-BMP5
MPL-B1520U	7000	1.80	0.49 (4.3)	5.90	1.53 (13.3)	0.27	2094-BMP5
				6.10	1.58 (13.9)		2094-BM01
MPL-B1530U	7000	2.0	0.90 (8.0)	5.90	2.34 (20.7)	0.39	2094-BMP5
				7.20	2.82 (24.9)		2094-BM01
MPL-B210V	8000	1.75	0.55 (4.9)	5.80	1.52 (13.4)	0.37	2094-BMP5
MPL-B220T	6000	3.30	1.61 (14.2)	5.90	2.50 (21.3)	0.62	2094-BMP5
				11.3	4.74 (41.9)		2094-BM01
MPL-B230P	5000	2.60	2.10 (18.6)	5.90	4.30 (38.0)	0.86	2094-BMP5
				11.3	8.20 (73.0)		2094-BM01
MPL-B310P	5000	2.4	1.6 (14)	5.90	3.2 (28)	0.77	2094-BMP5
				7.10	3.6 (32)		2094-BM01
MPL-B320P	5000	4.0	2.70 (24)	5.90	3.9 (34)	1.4	2094-BMP5
		4.5	3.10 (27)	13.0	7.5 (66)		2094-BM01
MPL-B330P	5000	6.1	4.18 (37)	13.0	8.0 (71)	1.7	2094-BM01
				19.0	11.1 (98)		2094-BM02
MPL-B420P	5000	6.3	4.74 (42)	13.0	8.7 (77)	1.9	2094-BM01
				21.8	13.4 (118)		2094-BM02
				22.0	13.5 (119)		2094-BM03
MPL-B430P	5000	8.6	6.11 (54)	13.0	8.8 (78)	2.2	2094-BM01
		9.2	6.55 (58)	21.8	14.4 (127)		2094-BM02
				32.0	19.8 (175)		2094-BM03
MPL-B4520P	5000	8.1	5.64 (50)	13.0	8.1 (72)	2.1	2094-BM01
				21.8	12.4 (110)		2094-BM02
				25.0	13.75 (121)		2094-BM03
MPL-B4530F	3000	6.7	8.36 (74)	13.0	13.9 (123)	2.1	2094-BM01
				21.0	20.3 (180)		2094-BM02
MPL-B4530K	4000	8.6	7.16 (63)	13.0	9.9 (87)	2.5	2094-BM01
		9.9	8.25 (73)	21.8	15.5 (137)		2094-BM02
				31.0	20.3 (179)		2094-BM03

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	Kinetix 6000 460V Drives Cat. No.
MPL-B4540F	3000	8.6	9.75 (86)	13.0	13.5 (119)	2.6	2094-BM01
		9.1	10.20 (90)	21.8	21.4 (189)		2094-BM02
				29.0	27.1 (240)		2094-BM03
MPL-B4560F	3000	8.6	10.1 (89)	13.0	14.7 (130)	3.1	2094-BM01
		11.8	14.0 (124)	21.8	23.3 (206)		2094-BM02
				36.0	34.4 (304)		2094-BM03
MPL-B520K	4000	8.6	8.09 (71)	13.0	10.9 (96)	2.3	2094-BM01
		11.5	10.7 (95)	21.8	17.0 (150)	3.1	2094-BM02
				33.0	23.2 (205)		2094-BM03
MPL-B540D	2000	8.6	15.8 (140)	13.0	23.6 (208)	3.4	2094-BM01
		10.5	19.4 (172)	21.8	38.8 (343)		2094-BM02
				23.0	41.0 (362)		2094-BM03
MPL-B540K	4000	20.4	19.4 (171)	45.0	38.1 (337)	5.0	2094-BM03
				60.0	48.6 (430)		2094-BM05
MPL-B560F	3000	20.9	26.7 (236)	45.0	49.3 (436)	5.5	2094-BM03
				68.0	67.7 (599)		2094-BM05
MPL-B580F	3000	26.1	34.0 (300)	45.0	51.0 (451)	7.2	2094-BM03
				73.4	74.3 (657)		2094-BM05
MPL-B580J	3800	30.0	31.8 (281)	45.0	43.7 (386)	8.4	2094-BM03
		32.0	33.9 (299)	73.4	66.6 (589)		2094-BM05
MPL-B640F	3000	30.0	34.2 (302)	45.0	50.8 (449)	5.6	2094-BM03
		32.0	36.7 (324)	65.0	72.7 (643)		2094-BM05
MPL-B660F	3000	38.5	47.9 (423)	73.4	81.0 (716)	4.5	2094-BM05
MPL-B680D	2000	34.0	62.8 (555)	73.4	124 (1098)	9.3	2094-BM05
MPL-B680F	3000	47.9	59.7 (528)	73.4	85.4 (755)	4.2	2094-BM05
MPL-B860D	2000	47.3	83.2 (736)	73.4	120 (1065)	13.3	2094-BM05
MPL-B880C	1500	47.5	109 (965)	73.4	157 (1387)	12.7	2094-BM05
MPL-B880D	2000	48.9	79.9 (706)	73.4	114 (1011)	12.7	2094-BM05
MPL-B960B	1200	42.5	130 (1150)	73.4	190 (1684)	9.8	2094-BM05
MPL-B960C	1500	48.9	110 (975)	73.4	146 (1296)	13.0	2094-BM05
MPL-B960D	2000	48.9	86 (760)	73.4	131 (1158)	15.0	2094-BM05
MPL-B980B	1000	40.0	162 (1440)	73.4	235 (2077)	9.7	2094-BM05
MPL-B980C	1500	48.9	112 (996)	73.4	157 (1387)	15.3	2094-BM05
MPL-B980D	2000	48.9	97 (858)	73.4	147 (1300)	18.6	2094-BM05

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.



## Kinetix 6000 Drives/1326AB (460V) Motors Performance Specifications

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	Kinetix 6000 460V Drives Cat. No.
1326AB-B410G	5000	3.4	2.7 (24)	5.9	4.6 (41)	1.0	2094-BMP5
				10.3	8.1 (72)		2094-BM01
1326AB-B410J	7250	4.9	2.7 (24)	13.0	7.2 (64)	1.4	2094-BM01
				14.6	8.1 (72)		2094-BM02
1326AB-B420E	3000	4.0	5.0 (44)	5.9	7.8 (70)	1.1	2094-BMP5
				11.3	14.9 (132)		2094-BM01
1326AB-B420H	6000	7.7	5.1 (45)	13.0	8.6 (76)	2.1	2094-BM01
				21.1	14.0 (124)		2094-BM02
1326AB-B430E	3000	5.5	6.6 (58)	13.0	15.6 (138)	1.5	2094-BM01
				16.4	19.7 (174)		2094-BM02
1326AB-B430G	5000	7.9	6.4 (57)	13.0	10.5 (93)	2.3	2094-BM01
				21.1	17.2 (152)		2094-BM02
1326AB-B515E	3000	8.7	10.4 (92)	13.0	15.6 (138)	2.0	2094-BM01
				21.8	26.1 (231)		2094-BM02
				26.0	31.1 (275)		2094-BM03
1326AB-B515G	5000	8.7	6.6 (58)	13.0	9.9 (88)	2.5	2094-BM01
		13.6	10.4 (92)	21.8	16.6 (147)	3.4	2094-BM02
				41.0	31.4 (278)	4.0	2094-BM03
1326AB-B520E	3000	8.7	12.0 (106)	13.0	17.8 (157)	1.3	2094-BM01
		9.5	13 (115)	21.8	29.9 (264)	1.7	2094-BM02
				28.4	39.0 (345)	2.3	2094-BM03
1326AB-B520F	3500	8.7	9.1 (81)	13.0	13.7 (121)	2.2	2094-BM01
		12.4	13.1 (116)	21.8	23.0 (203)	2.7	2094-BM02
				37.3	39.3 (347)	3.1	2094-BM03
1326AB-B530E	3000	8.7	11.7 (103)	13.0	17.5 (155)	2.2	2094-BM01
		13.4	18.0 (160)	21.8	29.3 (259)	3.4	2094-BM02
				40.0	54.0 (477)		2094-BM03
1326AB-B720E	3500	14.6	18.0 (159)	21.8	27.0 (239)	2.0	2094-BM02
		24.8	30.7 (271)	45.0	55.6 (492)	4.7	2094-BM03
				70.7	87.7 (775)	6.0	2094-BM05
1326AB-B720F	5000	30.0	23.9 (211)	45.0	36.0 (318)	10.1	2094-BM03
		39.5	31.7 (280)	70.7	56.7 (501)		2094-BM05
1326AB-B730E	3400	30.0	36.1 (319)	40.0	54.2 (479)	9.3	2094-BM03
		32.3	38.9 (344)	70.7	85.3 (754)		2094-BM05

Motor Cat. No.	Max Speed rpm	System Continuous Stall Current A 0-pk	System Continuous Stall Torque Nm (lb-in)	System Peak Stall Current A 0-pk	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	Kinetix 6000 460V Drives Cat. No.
1326AB-B740C	2200	14.6	26.1 (231)	21.8	39.0 (345)	5.2	2094-BM02
		29.7	53.2 (470)	40.0	80.6 (713)	6.5	2094-BM03
				70.7	127 (1123)		2094-BM05
1326AB-B740E	3400	30.0	33.5 (296)	45.0	50.4 (446)	11.3	2094-BM03
		45.3	50.8 (449)	70.7	79.3 (701)		2094-BM05

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

### Kinetix 6000 Drives/1326AS (460V) Motors Performance Specifications

Motor Cat. No.	Maximum Speed rpm	System Continuous Stall Current Amps (rms)	System Continuous Torque Nm (lb-in)	System Peak Stall Current Amps (rms)	System Peak Stall Torque Nm (lb-in)	Motor Rated Output kW	Kinetix 6000 460V Drives Cat. No.
1326AS-B310H	6200	0.8	0.70 (6.1)	2.4	2.10 (18)	0.3	2094-BMP5
1326AS-B330H	6500	2.1	2.10 (18)	6.0	5.60 (50)	0.9	2094-BM01
1326AS-B420G	5250	2.6	3.20 (28)	7.8	9.60 (84)	1.2	2094-BM01
1326AS-B440G	5250	5.4	6.40 (56)	16.2	19.0 (168)	2.0	2094-BM03
1326AS-B460F	4300	6.2	9.0 (80)	18.6	27.1 (240)	2.8	2094-BM03
1326AS-B630F	4500	7.8	10.7 (95)	18.5	25.4 (225)	2.4	2094-BM03
1326AS-B660E	3000	11.8	21.5 (190)	29.8	54.2 (480)	3.4	2094-BM05
1326AS-B690E	3000	19.0	36.4 (322)	41.3	79.1 (700)	5.0	2094-BM05
1326AS-B840E	3000	21.2	37.6 (333)	39.5	70.0 (620)	4.7	2094-BM05
1326AS-B860C	2000	17.6	49.3 (436)	44.4	124 (1100)	6.0	2094-BM05

Performance specification data and curves reflect nominal system performance of a typical system with motor at 40 °C (104 °F) and drive at 50 °C (122 °F) ambient and rated line voltage. For additional information on ambient and line conditions, refer to the Motion Analyzer CD, publication PST-SG003.

## Converting Your GML Software to RSLogix 5000 Software

The 1394 (GMC and GMC Turbo) motion controllers use Graphical Motion Language (GML) software for motion control programming. This programming conversion is based on the use of GML Commander software.

GML Commander software uses RS-232 serial networking to download and monitor GML Commander driven application programs to the 1394 GMC or GMC Turbo motion controller. The Kinetix 6000 servo drives use a Logix controller platform, a Logix SERCOS interface motion module, RSLogix 5000 software, and communication is over a fiber-optic network.

This section covers points to consider when converting from GML software to RSLogix 5000 software.

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### Introduction

In general, there is an equivalent RSLogix 5000 motion instruction or application code for each GML function block. While not all instruction data entry is the same, there are ways to convert a function in GML software to a similar RSLogix 5000 software motion instruction.

You can double-click each function block in the GML diagram to view or edit the configuration and connect the function blocks in the order that you want them to execute. With RSLogix 5000 software, you typically program the motion instructions in ladder logic and sequence the program by the way you interlock the rungs of logic. Also, the ladder logic instructions are configured on the same screen as the screen used to enter and edit your ladder logic code.

You can trace the program flow when troubleshooting a GML program. Use state logic programming style to troubleshoot RSLogix 5000 programming code. Both programs use motion direct

commands for simple motion instruction execution outside of the main program.

GML code is sequential functions executed task-based on the requirement in the application. Therefore, GML code is best emulated in RSLogix 5000 software by using Sequential Function Chart (SFC) programming. However, because ladder diagrams are the industry standard in PLC programming and similar functions, this manual focuses on converting your GML Commander program to an RSLogix 5000 program using ladder diagrams. Also, ladder diagrams are scan-based programs and are not executed or handled exactly like a GML Commander program in the 1394 motion controller. Many of those sequence-versus-scan differences are explained in Comparing GML and RSLogix 5000 Programming Software beginning on page 75.

## **GML Software Overview**

The standard GMC (catalog numbers 1394x-SJTxx-C and 1394C-SJTxx-L) and GMC Turbo (catalog number 1394x-SJTxx-T) motion control systems use GML software. GML is a sequential, flow-chart oriented approach to motion control programming. GML Commander software is the emulation of many years of improvement in the GML software family and is used in this transition process.

When using GML software, you create a diagram of your application solution by placing function blocks representing actions on the screen and connecting them in the proper order to achieve the sequence of operations needed for your application. You enter motion and process details later using a fill-in-the-blank approach. Once completed, you translate the diagram into a script in the native language of the motion controller and download the script to the motion controller via serial communication.

For a complete list of the GML function blocks and a description of their use, refer to the GML Commander Reference Manual, publication [GMLC-5.2](#).

## **RSLogix 5000 Software Overview**

RSLogix 5000 Enterprise Series software is designed to work with the Rockwell Automation ControlLogix, CompactLogix, FlexLogix, SoftLogix5800, and DriveLogix controller platforms. With RSLogix 5000 software, you need only one software package for sequential, process, drive, and motion control programming.

- RSLogix 5000 software offers an easy-to-use, IEC 61131-3 compliant interface, symbolic programming with structures and arrays, and a comprehensive instruction set that serves many types of applications.
- RSLogix 5000 software supports relay ladder diagrams, structured text, function block diagrams, and sequential function charts for developing application programs.
- Each motion instruction works on one or more axes.
- Each instruction needs a unique motion control tag. The tag uses the MOTION\_INSTRUCTION data type. The tag stores the status information for the instruction.
- Additionally, RSLogix 5000 software provides support for the S88 equipment phase-state model for batch and machine control applications via the (optional) PhaseManager feature.

For a complete list of RSLogix 5000 motion instructions and a description of their use, refer to the Logix5000 Controllers Motion Instructions Reference Manual, publication [1756-RM007](#).

## 1394 Communication Platforms

The 1394 standard GMC system modules support the use of Remote I/O (RIO), Axislink, DH-485, RS-422, and RS-232 serial devices. Additionally, GMC Turbo system modules provides an SLC interface for I/O bit/word file transfer between the 1394 system running GML software and the SLC controller running RSLogix 500 software.

Complex applications, such as line shaft (multiple-axis coordination) capability, require interfacing to the HMI terminal, programmable logic controller (PLC), or other 1394 GMC system modules. GML Commander software and the 1394 motion controller use these networks for proper data flow to and from each device. The handshaking between the 1394 motion controller and the PLC module is required for proper application flow.

RSLogix 5000 software contains both the sequential process and motion instructions in one language. Using the Logix controller system, you eliminate the handshaking from one program controlling sequential logic, and the other handling the motion control instructions. You have to determine where your machine I/O is coming from, how to structure it into the Logix backplane, and to associate the various motion functions. In addition, use of an HMI terminal ties directly to the Logix backplane such that machine status, machine recipe, and other functions can tie into various required motion functions.

### *Remote I/O*

Remote I/O (RIO) is used from the PLC-5 or SLC module to the 1394 GMC system module for handshaking PLC I/O with data bit or block transfer to and from the 1394 motion control system. This is no longer required as the Logix controller uses one program to do both I/O, processing, and motion instructions.

RIO is also used as an interface to the HMI terminal. Your existing HMI terminal can be reused as well as the screens, but the interface to Logix needs to be retrofitted to accommodate the new platform.

There are four RIO Pallette interface instructions in GML software that are transparent when you use RSLogix 5000 software. The function of RIO is embedded in the RSLogix 5000 software code with sequential and motion instructions in the same rung of logic.

#### **RIO Pallette Interface Instructions**



### *DH-485 Serial Communication*

DH-485 serial communication is standard on GMC system modules and can be used in ways similar to RIO. The DH-485 serial ports use DH-485 value blocks or SLC message instructions to send/receive information from/to an HMI terminal. Either the existing HMI terminal could be used with the Logix controller or new networks and code created.

There are four DH-485 Pallette interface instructions in GML software that are transparent when you use RSLogix 5000 software. The function of DH-485 communication is embedded in the RSLogix 5000 software code with sequential and motion instructions in the same rung of logic.

#### **DH-485 Pallette Interface Instructions**



### *Turbo SLC I/O Bit/Word File Transfer*

SLC interface or backplane interface is only compatible with the 1394 GMC Turbo system module. With this option the SLC controller views the 1394 motion controller as a four slot SLC rack with the same backplane communication. The I/O data bits and words move back and forth in the RSLogix 500 and GML Commander software programs to turn on a servo or read back motor position, for example. RSLogix 5000 software does not require this handshaking as it is one program that handles both logic and motion in one rung/routine.

There are three SLC Pallete interface instructions in GML Commander software that are transparent when you use RSLogix 5000 software. These instructions are for the SLC module status.

#### **SLC Pallete Interface Instructions**



### *SLC Turbo Example*

Typically, the use of handshaking, whether RIO, DH-485, or Turbo Backplane, required the accessing of the other software to transfer data bits to start and stop a process from the HMI terminal, or to send position data from the motion controller back to the programmable controller, for example.

In this instance, the use of the SLC backplane and 1394 GMC Turbo system module provided dedicated I/O from the SLC RSLogix 500 software to and from the GML motion programming software.

An accumulator machine using motion control uses the following GML code to manually override an automatic condition with the use of an external switch/HMI terminal input. This external input is written through RSLogix 500 code (SLC) and then through data transfer using the 1394 GMC Turbo system module. The input can jog the accumulator slide forward or reverse.

In this rung of the RSLogix 500 program, you can determine if the axis should be in manual or automatic mode.

### RSLogix 500 Code Showing I/O Handshaking in GML Software



The code in rung 0002 indicates that if SLC input B13:0/15 (Automatic-Mode-Enabled bit) is off, the system is in manual mode. So, the accumulator can be jogged forward or reverse with an input.

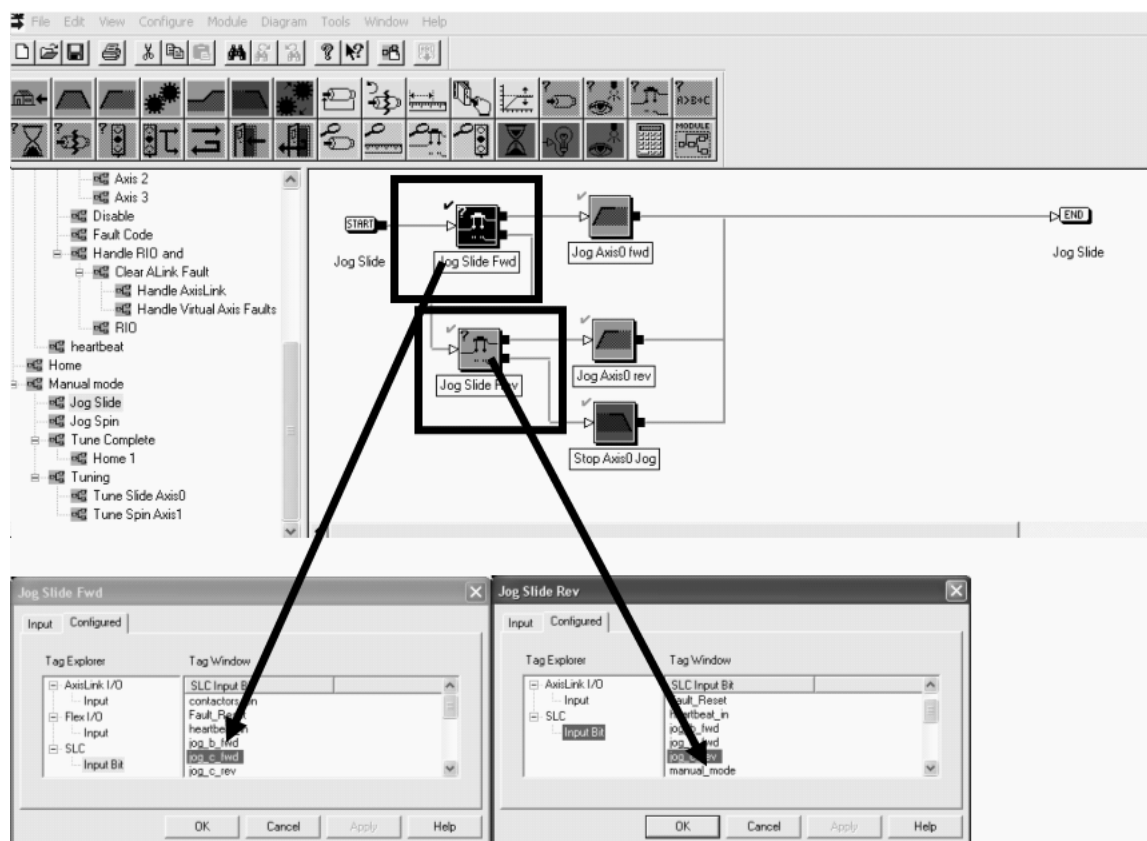
With the use of the 1394 GMC Turbo system, you are allowed 40 I/O data high-speed transfer. In this example, if the SLC input bit B13:0/4 is true, a SLC output bit O14:7 (which equals jog\_c\_fwd in GML programming) is triggered in the SLC module that corresponded to a SLC input bit in the 1394 GMC Turbo system module. In this case, the accumulator (called axis C) jogs forward at a floating point data value from the SLC module to 1394 GMC Turbo system module until the input is removed. Conversely, if the SLC input bit B13:0/15 (which equals jog\_c\_rev GML programming) is true, the accumulator will reverse jog.



In GML Commander software, the conditions of jogging the accumulator are tied into the input blocks. If the jog\_c\_fwd is true, you jog forward. If the jog\_c\_fwd is false you go to another input block. If the jog\_c\_rev is true, you jog reverse. If at that time the jog\_c\_rev is false, you stop jogging and end the routine.

This SLC input bit is transferred over the Bulletin 1746 SLC Backplane as the 1394 GMC Turbo system acts like a four-slot SLC rack. There is handshaking between the RSLogix 500 and GML software in order for this to actually occur.

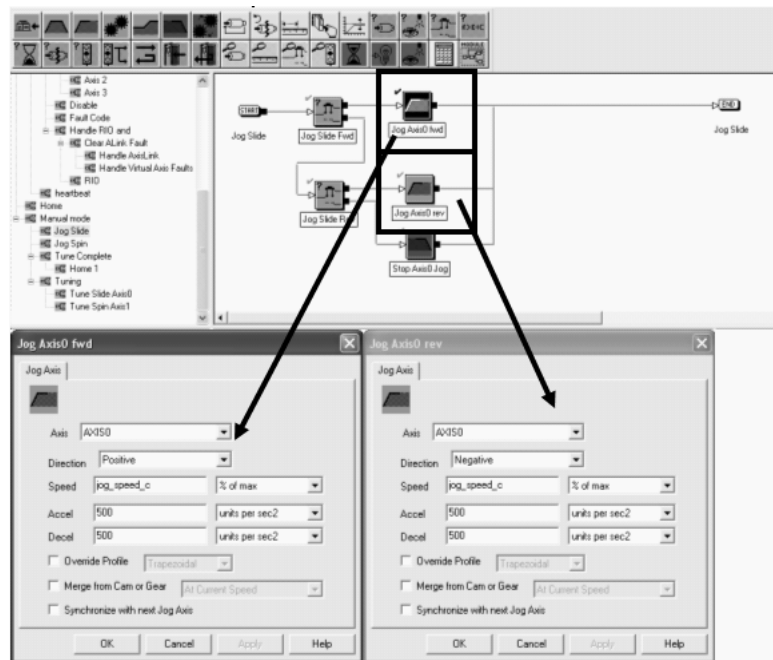
### GML Commander Input Blocks (using RSLogix 500 input)



Because the accumulator jogging speed and direction could be changed using an HMI terminal or the PLC, it is written as a variable.

In this example, the manual forward or reverse jog of the accumulator is written with a few motion instructions in GML software.

### GML Commander Move Block Variable (using RSLogix 500 variable for speed)



The JogAxis, of the accumulator properties, are the fill-in-the-blank folders within the GML motion instruction. Speed, jog\_speed\_c, is a variable. Use of the SLC module to 1394 GMC Turbo also allowed I/O floating point numbers to be sent along the I/O bits. The number of floats varied based on the number of I/O bits sent.

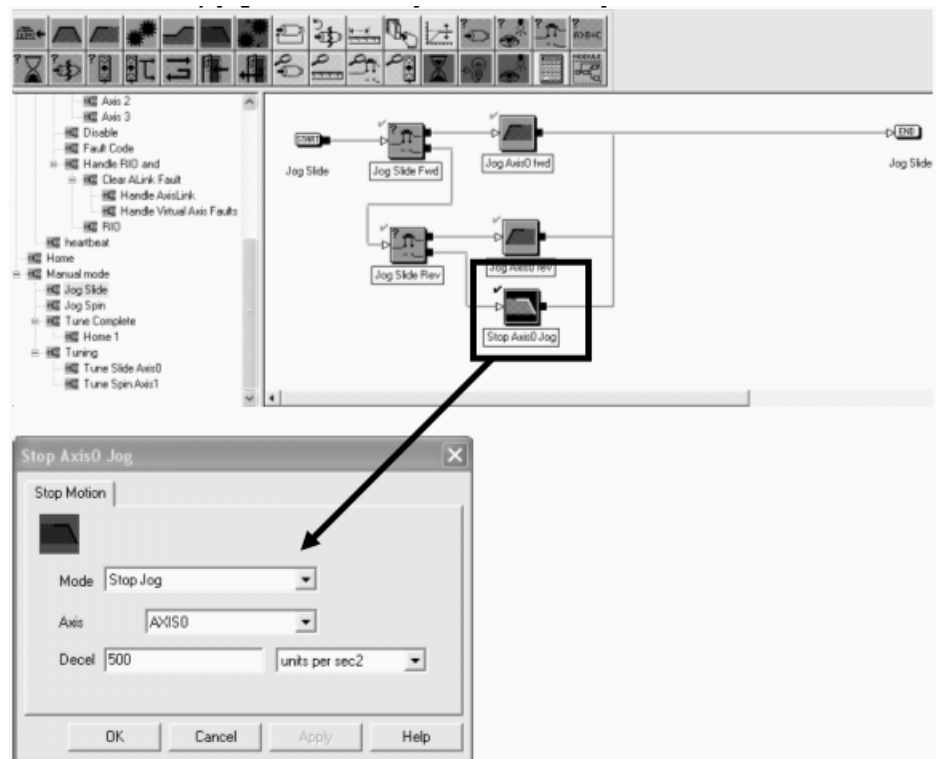
### RSLogix 500 Copy File (sending to GML variable speed)



The jog\_speed\_c variable is the accumulator jog speed. Jog\_speed\_c is entered in the PanelView terminal and networked to the SLC controller platform. This input to the SLC controller is transmitted to the 1394 motion controller (shown above in rung 0010), and becomes an input variable for both the forward and reverse jog blocks.

Many of the existing GML software settings for speed, acceleration, and deceleration could be used in the transition to RSLogix 5000 software and motion instructions.

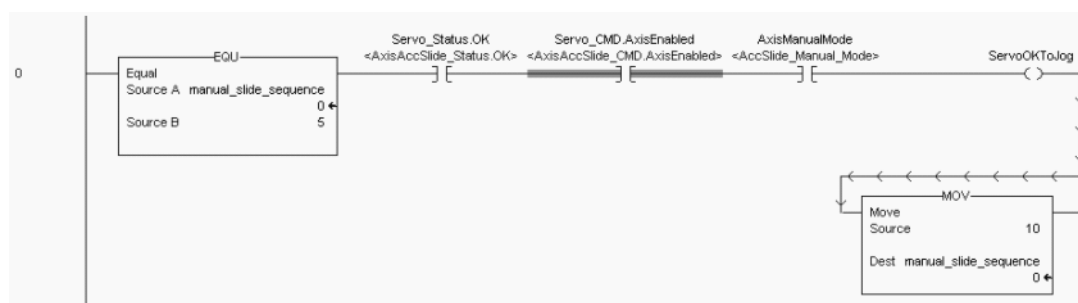
### GML Commander Code (Stop Command)



In summary, the SLC module generated an input from a switch or HMI terminal that triggered an output to the 1394 GMC system module to put the accumulator axis in a manual mode. Then, based on the need to jog the accumulator forward or reverse, the SLC module sent bit and floating point information to the GMC system module to complete these actions. When the actions were complete, the jog was stopped.

You can use RSLogix 5000 software and state logic to perform the same functions with one software package and several rungs of ladder logic. Use of interlocking tags, local to the software, complete the accumulator jog. State logic provides for the evaluation of where the program may be faulting or improperly functioning.

## RSLogix 5000 Code (Rung 0) Enable Manual Mode

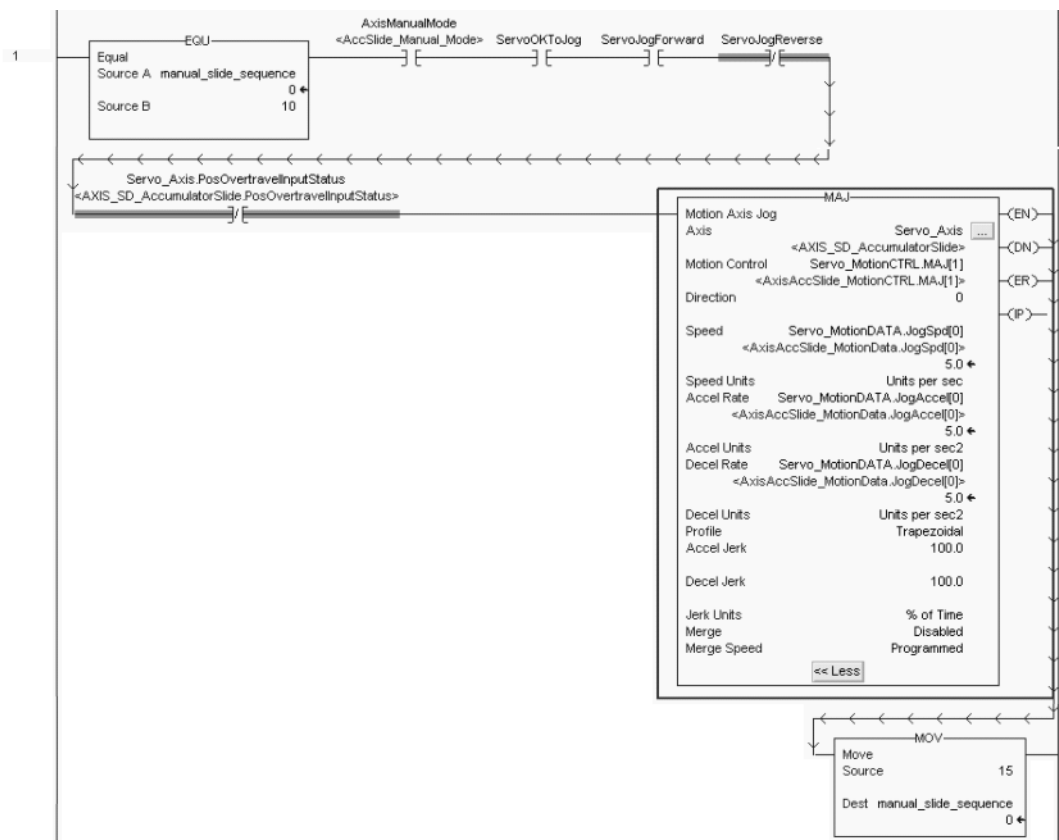


In rung 1, the axis jogs forward based on these five program interlocking criterion.

- Manual mode is selected.
- The ServoOKToJog tag (an output from rung 0 indicating this axis is enabled and not faulted).
- The forward jog input is given.
- The reverse jog input is not true.
- The servo axis Positive Overtravel input is not true.

The jog speed depends on a variable that comes from an HMI terminal.

### RSLogix 5000 Code (Rung 1) Jog Axis Forward

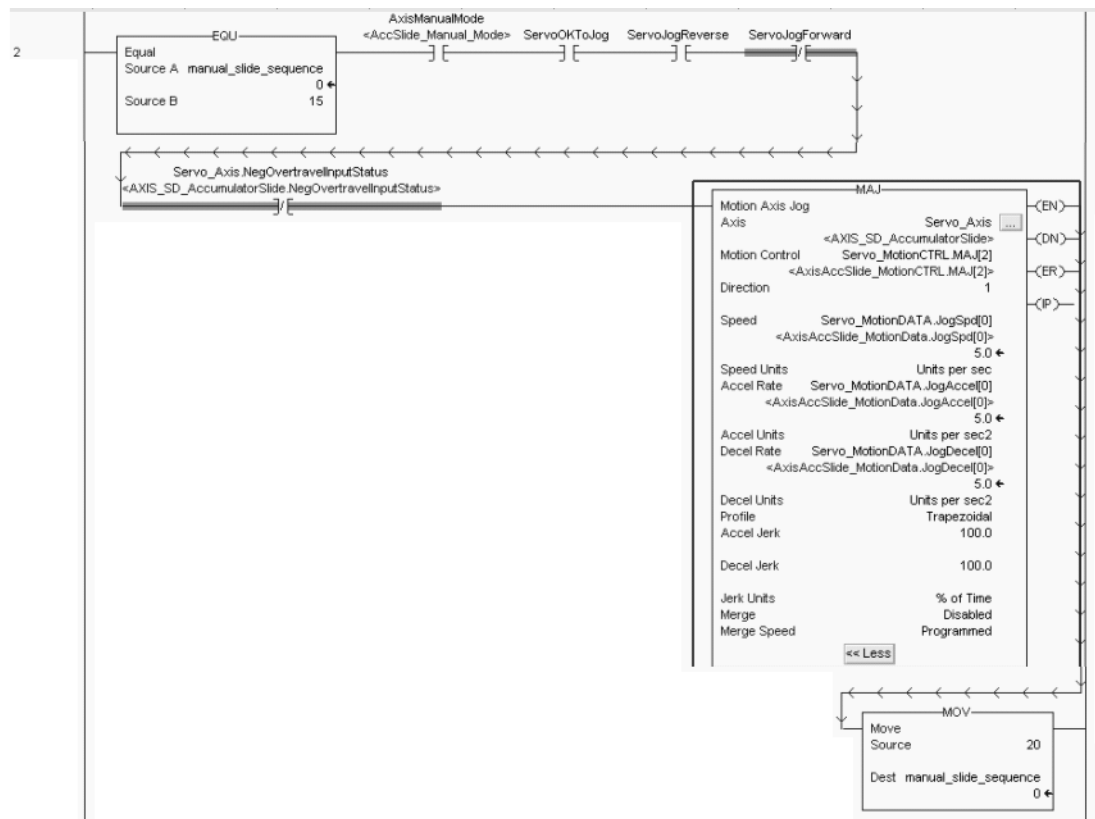


In rung 2, the axis jogs reverse based on these five program interlocking criterion.

- Manual mode is selected.
- The ServoOKToJog tag (an output from rung 0 indicating this axis is enabled and not faulted).
- The forward jog input is not true.
- The reverse jog input is given.
- The servo axis Negative Overtravel input is not true.

The jog speed depends on a variable that comes from an HMI terminal.

### RSLogix 5000 Code (Rung 2) Jog Axis Reverse

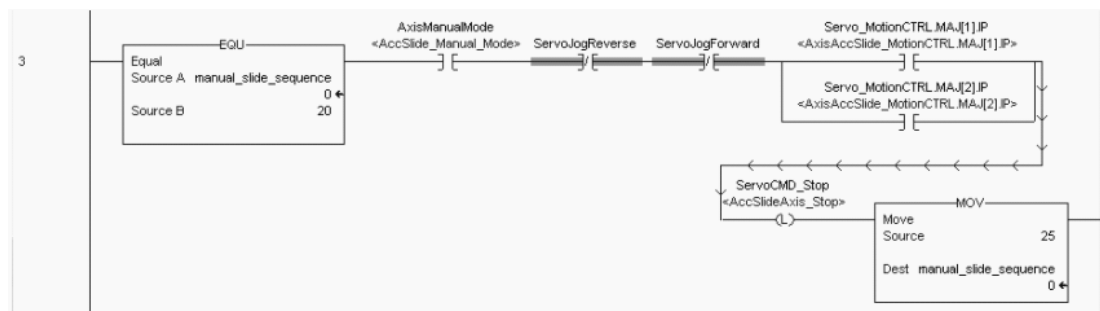


In rung 3, the axis stops jogging based on these four program interlocking criterion.

- Manual mode is selected.
- The forward jog input is not true.
- The reverse jog input is not true.
- One of the jog process bits (forward or reverse) is set indicating that the accumulator is jogging in one direction.

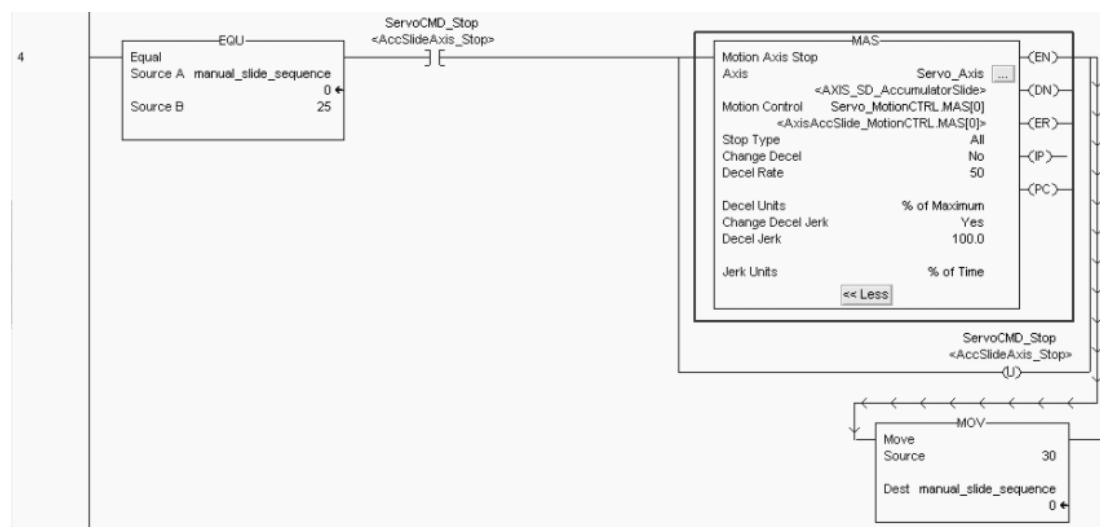
Rung 3 latches a Command Stop bit that is tied to rung 4 and contains the actual Motion Axis Stop command.

### RSLogix 5000 Code (Rung 3) Latch Stop Bit



In rung 4, the ServoCMD bit goes true and the Motion Axis Stop occurs. Finally, the ServoCMD bit is unlatched, so the next jog (for example) can occur.

### RSLogix 5000 Code (Rung 4) Stop Axis Jog



In summary, the handshaking from the sequence programming (RSLogix 500) and the GML is eliminated. All of the inputs and outputs and motion instructions are in one (RSLogix 5000) software.

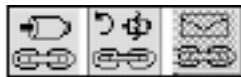
### *AxisLink*

AxisLink with an ALEC module uses an external encoder or one of the 1394 GMC system encoder emulations to link multiple motion controllers to provide real-time axis coordination between axes in a distributed 1394 GMC multi-axis system.

Each Logix processor can support up to 32 axes in a motion group.

- You can coordinate axes within the same motion group.
- You can have more than one processor in certain Logix configurations, providing additional axes, based on performance needs.

### **AxisLink Pallette Interface Instructions**



### *RS-422 and RS-232 Serial Communication*

RS-422 is a multi-drop serial communication network that can be used from one 1394 GMC system module to another 1394 GMC system module.

RS-232 is a common communication network used between the 1394 GMC controller and the personal computer containing GML Commander software.

There are nine RS-232 and RS-422 Pallette interface instructions. These instructions provide keying of information being sent back and forth through these two serial networks. Many of these functions are now handled in the RSLogix 5000 software from use of tag accessibility, Get System Value (GSV), Set System Value (SSV), Message (MSG), and ASCII instructions.

### **RS-232 and RS-422 Pallette Interface Instructions**



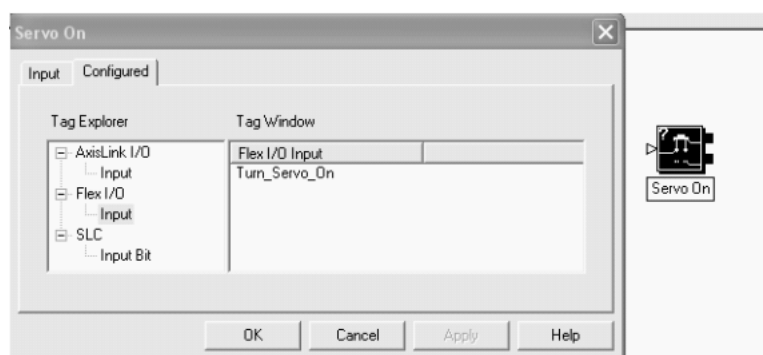


## Flex I/O

The 1394 GMC system accepts up to eight Flex I/O modules into a dedicated Flex I/O connector on the system module. These are flexible inputs that look like local I/O and can be used in the GML software code for varying types of machine control.

In this example, the GML input block turns on a servo motor with the Flex I/O input named Turn\_Servo\_On. This input is likely wired from an external switch (not shown here).

### GML Input Block Using Flex I/O Input



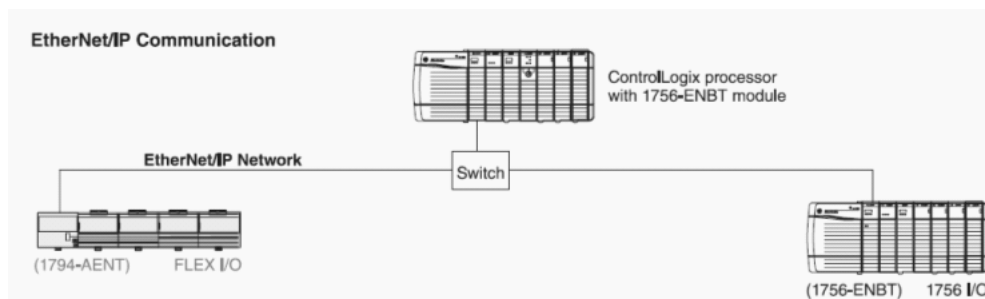
### 1394 GMC Compatible Flex I/O Blocks

Bulletin 1794 Flex I/O Blocks	
Cat. No.	Function
1794-IB16	Discrete Input
1794-OB16	Discrete Output
1794-IE8	Analog Input
1794-OE4	Analog Output
1794-IE4XOE2	Analog Combo
1794-IA8	Discrete AC Input

Bulletin 1794 Flex I/O Blocks	
Cat. No.	Function
1794-OA8	Discrete AC Output
1794-IB10XOB6	Discrete Combo
1794-OW8	Relay Output
1794-IF41	Isolated Analog Input
1794-OB16P	Discrete Output

To reuse the Flex I/O connections that are already in the system requires using the proper network interface block and then rewriting internal RSLogix 5000 software code to access the Flex I/O blocks. In this example, the Bulletin 1794-AENT adapter module communicates via ethernet between the Flex I/O modules and ControlLogix controller.

### Flex I/O Networked via EtherNet/IP to Logix Controller



The Kinetix 6000 drive has a limited number of dedicated inputs. However, ControlLogix and CompactLogix controller platforms have various I/O modules that replace Flex I/O modules and interface to the motion instructions through RSLogix 5000 software.

If you decide to convert to Logix I/O modules, go to <http://www.ab.com/e-tools> and follow the appropriate links for programmable controllers and distributed I/O selection tools. The tool is designed to help you determine which ControlLogix or CompactLogix I/O modules you need.

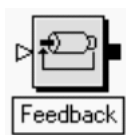
## Comparing GML and RSLogix 5000 Programming Software

Many of the function blocks in GML software are similar, in function, to the motion instructions used in RSLogix 5000 software. This section explains the similarities and differences between them, and points out how the Logix instructions or code usage corresponds to each of the GML function blocks.

### *Sample MSO Instruction Using RSLogix 5000 Software*

The Feedback block in GML software is used to turn on the selected drive enable output, which enables feedback loop processing.

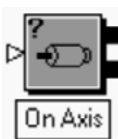
#### **GML Feedback Block**



However, another function block is needed to tell the program that the axis is ready to be moved. The On Axis block can be used two ways.

- Wait-For-Axis or the input to pause the program
- If-Axis or input to trigger program flow

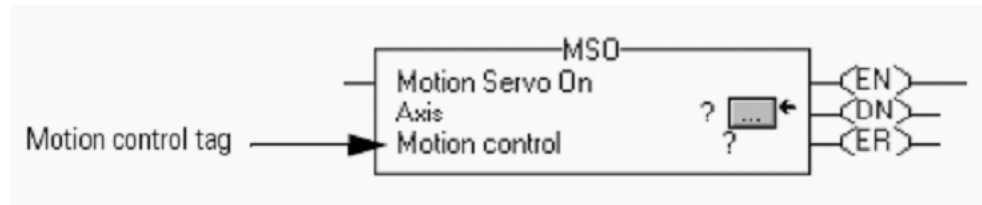
#### **GML On Axis Block**



RSLogix 5000 software uses the Motion Servo On (MSO) motion instruction to activate the servo amplifier and to activate the servo axis control loop. The actual tags associated with the Axis\_Servo\_Drive axis type can be used for interlocking the program to make sure a move command is not initiated until the Axis Feedback block is on. No other instruction is required.

The MSO block is used in ladder diagrams (or structured text) and used on an Axis\_Servo\_Drive for use on a SERCOS Network.

### RSLogix 5000 MSO Instruction



Axis ? is the name of the axis to perform the function on. Axes are configured in your RSLogix 5000 software program.

Motion control ? is the structure used to access instruction status parameters. The motion control tag indicates the health of the motion instruction. Use it to determine if the instruction was executed or for interlocking other program instructions.

Mnemonic tags associate each motion instruction. In this example, there are three tags.

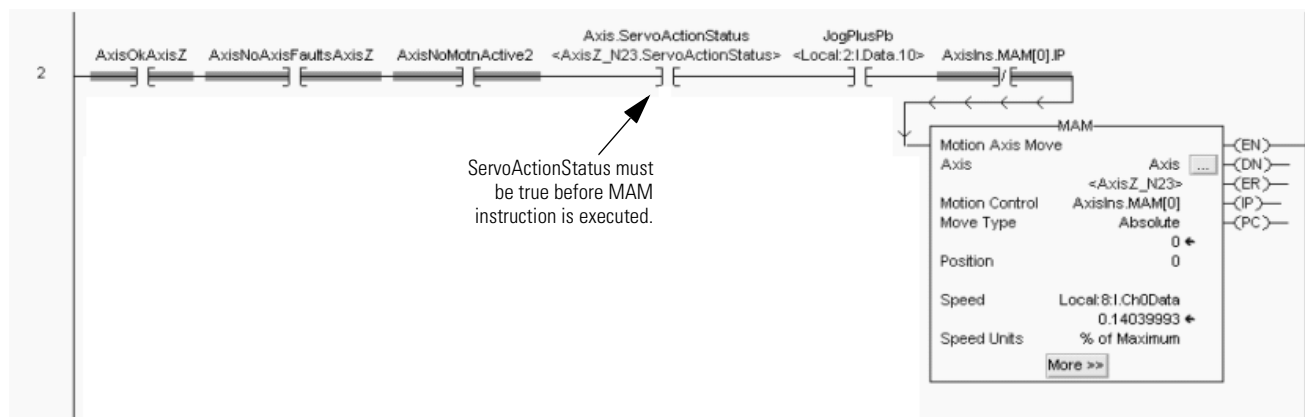
EN is the Enable bit. This bit is set when the rung makes a false-to-true transition and remains set until the servo message transaction is completed and the rung goes false.

DN is the Done bit. The DN bit is set when the axis' servo action has been successfully enabled and the drive enable status bit has been set.

After the DN bit is set, BrakeReleaseDelayTime expires and the ServoActionStatus bit is set. The ServoActionStatus bit can be used as part of the interlocking before a move occurs.

ER is the Error bit. The ER bit is set to indicate that the instruction detected an error.

### RSLogix 5000 Code Example Using Interlocking Before MAM Instruction Executes



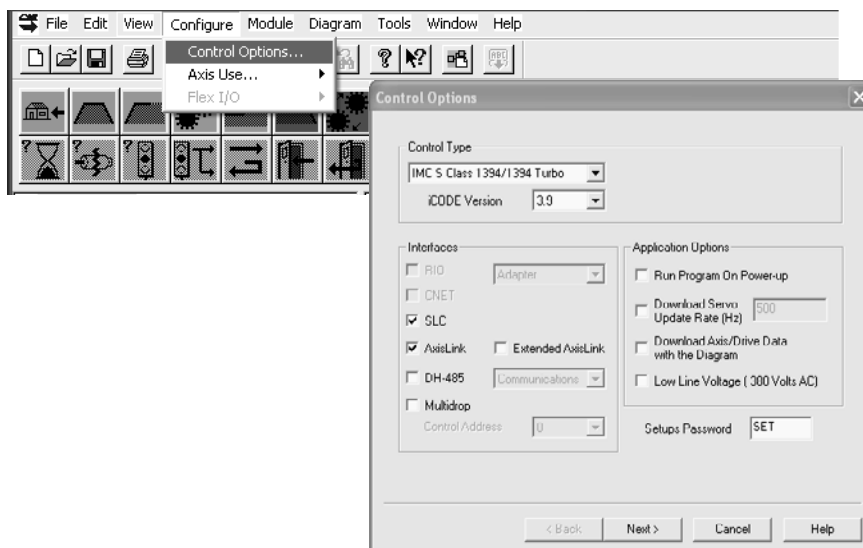
### *Control Options/Axis Setup*

The Control Options dialog in GML software determines how the 1394 GMC system module is configured. These are the available options:

- Communication network interfaces
- Application options for running the program
- Number of servo axes on the system module
- Operator interface port
- Flex I/O
- Smart Power for shunt and dc common bus
- SLC and Turbo I/O data
- AxisLink node addresses

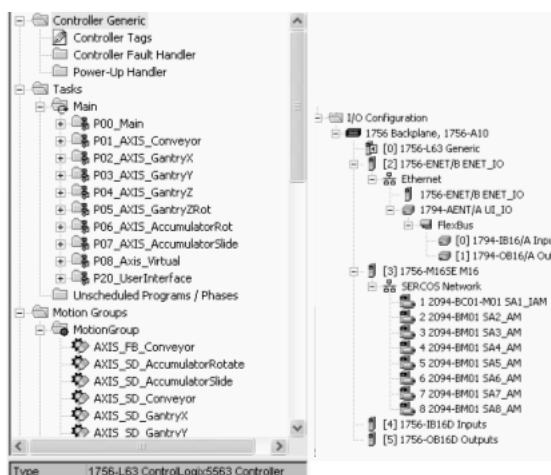
In this example, the 1394 GMC Turbo system module is setup to use AxisLink and the SLC interface.

### **GML Commander Control Options**



RSLogix 5000 software uses the Controller Organizer to setup the specific processor used, the Coordinated System Time Master, the Motion Group with up to 32 axes per group, and finally the I/O Configuration including the SERCOS network and the Kinetix 6000 IAM and AM modules in that network.

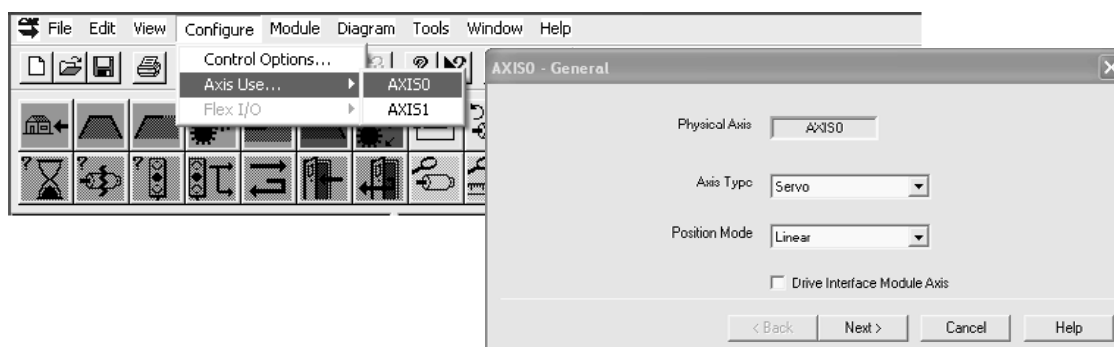
## RSLogix 5000 Controller Organizer



Axis Setup in GML software and Axis Properties in RSLogix 5000 both provide a way to configure axes for their intended use.

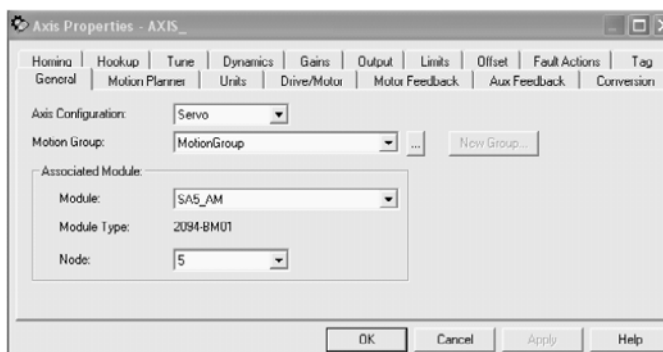
This example shows the Axis Setup dialog (General tab) in GML software.

## GML Commander Axis Setup (General)



This example shows the Axis Properties dialog (General tab) in RSLogix 5000 software.

## RSLogix 5000 Axis Properties (General Tab)



### Axis Setup Summary Comparing GML and RSLogix 5000 Software

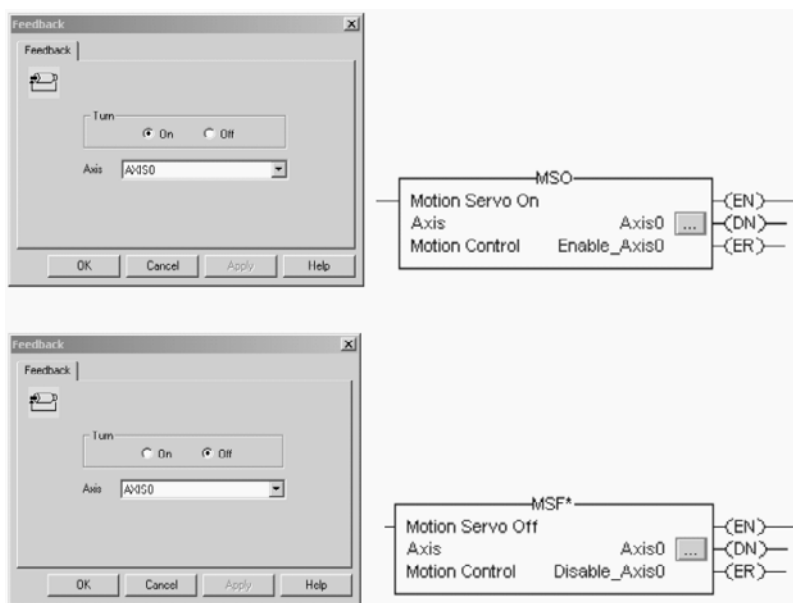
GML Software Setup Tab	Axis Setup Description in GML Software	Axis Setup Conversion in RSLogix 5000 Software
General	The General tab is used to setup Axis Type and Position Mode. It is also used to configure the Drive Interface Module (DIM).	Use the General tab to configure the Axis Type, Motion Group and Axis Module that the axis is associated with. Use the Conversion tab to configure the position mode (rotary or linear). The 1394 DIM module is not used or supported in RSLogix 5000 software.
Units	The Position Units tab is used to setup the actual type of position units in addition to position, velocity, accel, and decel display format.	Use the Units tab to set the position units. Display of position/velocity/accel/decel are set in the Axis_Servo_Drive tag structure.
Feedback	The Feedback tab is used to setup the transducer type, indicating motor resolver or other, as the position feedback. It also sets the conversion and external conversion constants and unwind data, if rotary. If using a Master position axis, you could use an encoder filter for the position signals sent to slave type axis.	Use the Motor Feedback tab to verify the feedback type (field is filled when motor catalog number is known) and to set cycles/rev, interpolation factor, and feedback resolution. The Conversion tab is used to set position mode, conversion constant, and unwind data.
Positioning	The Positioning tab sets the default Move and Jog Profiles. It also sets the Position Lock Tolerance, the Backlash Compensation, if a linear axis were used, and the average velocity timebase.	The default Axis Move and Jog Profiles are set when using the specific MAM and MAJ instructions. Position Lock Tolerance is set in the Limits tab. Backlash compensation is set in the Offset tab and average velocity timebase is set in the Units tab.
Homing	The Homing tab is used to configure an active or passive home. The absolute MV is used to configure an external absolute resolver/encoder interface for absolute positioning.	The Homing tab lets you configure a similar homing sequence. However, the addition of Immediate, Absolute, and Torque Level are added. The Immediate sequence must be used with the Absolute mode setting when the drive is disabled. The Absolute Reference Bit lets the axis retain position (within 4096 revs) while all power is down.
Overtravel	The Overtravel tab is used to configure hard and soft travel limits. If the hard overtravel limit is used, it is wired into the GMC System Module.	Use the Limits tab to configure hard and soft travel limits. These physical inputs are wired to the Kinetix 6000 drive I/O (IOD) connector.
Motor/Drive	The Motor/Drive tab is used to select the motor catalog number, configure the motor velocity and torque limits, and configure the motor thermal circuitry.	Use the Drive/Motor tab to select the motor, amplifier, and the loop configuration. Use the Limits tab to set the continuous/peak torque values for your drive/motor combination. The Dynamics tab is used to set the maximum application speed and accel, decel, and jerk values (an autotune will automatically set the dynamics tab values).
Fault Action	The Fault Action tab is used to configure the system to Disable Drive, Stop Motion, or Status Only when a fault occurs.	Use the Fault Actions tab to configure the system to Disable Drive, Stop Motion, Status Only, or Shutdown when a fault occurs.
Hookups	The Hookups tab configures the transducer polarity and control output polarity. The actual test is available when the personal computer and GML software is online with the applicable 1394 GMC System Module.	Use the Hookup tab to initiate a marker, feedback or test command test.
Tune	The Tune Servo action will optimize both Gains (position/velocity) and Dynamics (speed, accel/decel). You must be in online mode to configure. GML software automatically sets the Gains and Dynamics tabs after a successful tune.	The Logix Tune tab configures the Gains and Dynamics tabs. It also populates the Output tab with load to motor mismatch values and other variables. Tuning values developed in GML software are not an exact match to those in RSLogix 5000 software. However, you can use the GML settings as a starting point for the next system.
Gains	The Gains tab is populated from the Tune Servo action. Position and Velocity loop and Velocity Feedforward gains are also configured in this tab.	The Logix Gains tab similarly provides access to the system gains. Acceleration Feedforward is also included in Logix.
Dynamics	The Dynamics tab is populated from the Tune Servo action. Maximum speed, acceleration/deceleration, and Error Tolerance parameters are set.	The Dynamics tab parameters are set by the Tune action and similarly provides access to the maximum speed, acceleration and deceleration parameters. Maximum jerk is added in the version 16 release. The Tune action also sets the Position Error Tolerance parameter, listed on the Limits tab.

### *Enable/Disable Axis*

The Feedback block is used in GML software to enable and disable the axis. In RSLogix 5000 software a separate motion instruction is used to enable or disable the axis. The MSO instruction is used to enable the axis and the MSF instruction is used to disable the axis.

To convert from GML to RSLogix 5000 software, the appropriate instruction needs to be added to the ladder diagram and the axis tag name needs to be added in the axis parameter of the motion instruction.

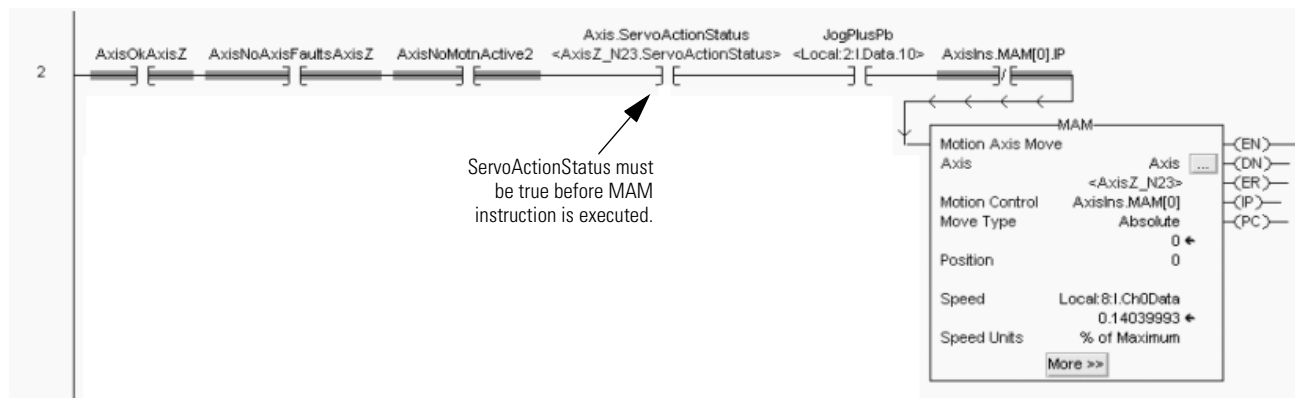
#### **GML Feedback Block and RSLogix 5000 MSO/MSF Instruction**





The MSO block in RSLogix 5000 software works with the brake disengage time to set a servo action status bit that can be used to interlock any other rungs with commanded motion. In this way no motion is commanded to overdrive the brake.

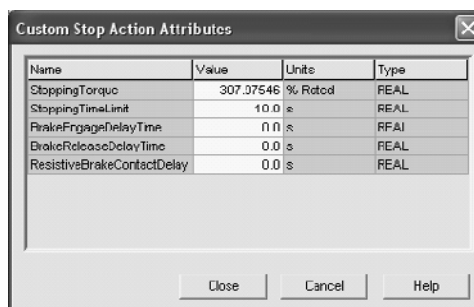
### RSLogix 5000 Code Example Servo Action Status Bit is True Before MAM Instruction Executes



The MSF command works with the brake engage time to apply full-rated torque while the brake engages. After this time elapses, the servo IGBT circuits are disabled and de-energizes the servo action status bit.

The brake engage/disengage times are set in the Fault Actions/ Custom Stop Action Attributes dialog of the Axis Properties tab.

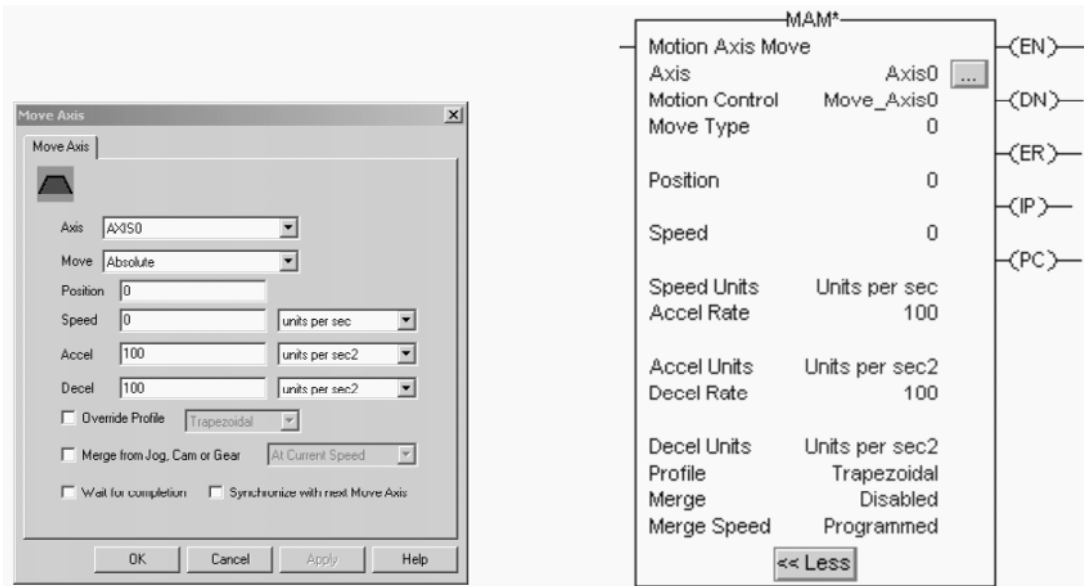
### RSLogix 5000 Axis Properties (Limits Tab/Custom Stop Action Attributes)



Move Axis

The Move Axis block is used in GML software to initiate a move on the axis. In RSLogix 5000 software a Motion Axis Move (MAM) instruction is used to initiate a move. The same move types are available on both types of instructions. If the Wait for Completion box is checked on a GML function block, you use the PC bit from the motion control tag in your ladder logic program to determine when the move is complete and interlock the next step in your sequence.

GML Move Axis Block and RSLogix 5000 MAM Instruction



Comparing Axis Move Parameters

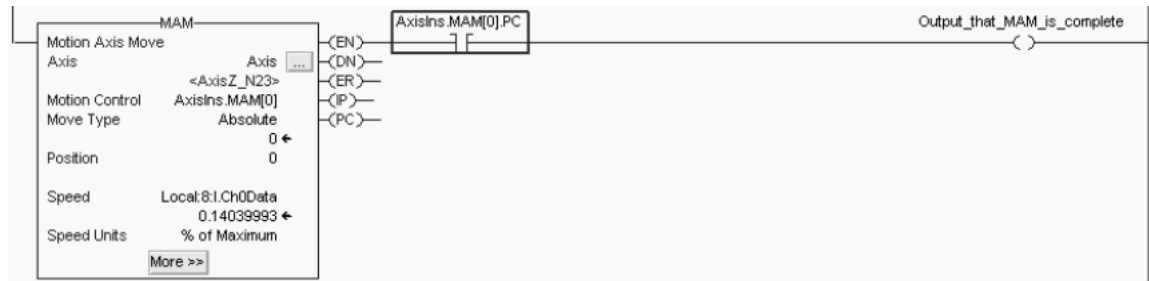
GML Software Parameter	RSLogix 5000 Software Parameter
Axis	Axis
Move	Move Type
Position	Position
Speed	Speed
Speed Units	Speed Units
Accel	Accel Rate
Accel Units	Accel Units

GML Software Parameter	RSLogix 5000 Software Parameter
Decel	Decel Rate
Decel Units	Decel Units
Override Profile	Profile
Merge	Merge Enable
Wait for Completion	N/A
Synchronize with next Move Axis	N/A

Wait for Completion is used in GMC systems to cause the motion controller to halt the current task until the execution of the current move block finished. RSLogix 5000 software is a scan-based programming system. The MAM instruction contains bits that you can use for program execution control, for example, the PC (process complete) bit.

In this example the MAM instruction is executed and when the PC bit is complete, the output turns on.

### RSLogix 5000 Code Example Using the MAM PC Bit to Set Output



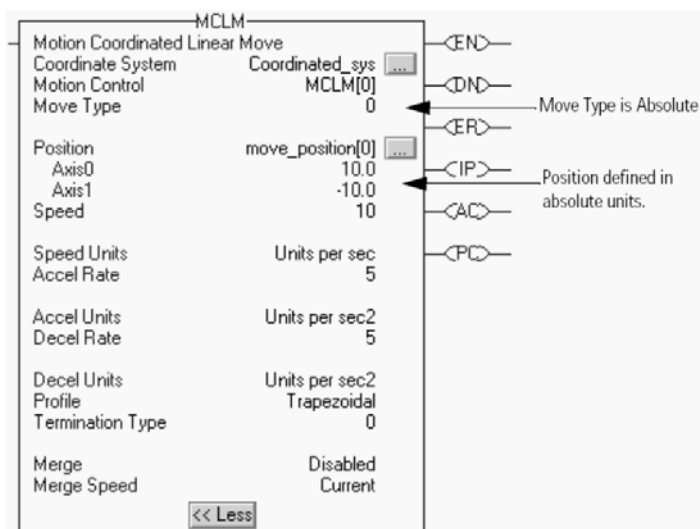
Synchronize-with-next-Move-Axis is used in GML software to run another Move Axis block on another axis simultaneously in the motion control task. In the RSLogix 5000 MAM instruction, this function is not available.

The best way to synchronize two axis moves in RSLogix 5000 software is to use the Motion Coordinated Linear Move (MCLM) instruction. In the example below, a coordinated time system is set up in RSLogix 5000 to coordinate Axis 0 and Axis 1. Once setup, a home position is established at a zero reference position. The attached MCLM instruction simultaneously moves Axis 0 to an absolute position of 10 and Axis 1 to an absolute position of -10.

#### IMPORTANT

GML software is a sequential-based programming language. Therefore, when two axis are synchronized this way they are moved or executed at the same time. Since RSLogix 5000 software is a scan-based language, the performance or execution is not immediate, instead it is based on the Motion Group Coarse Update Rate (CUR). A general rule of thumb is to expect execution no longer than 2x the CUR. In most instances of machine performance, this will not be noticeable.

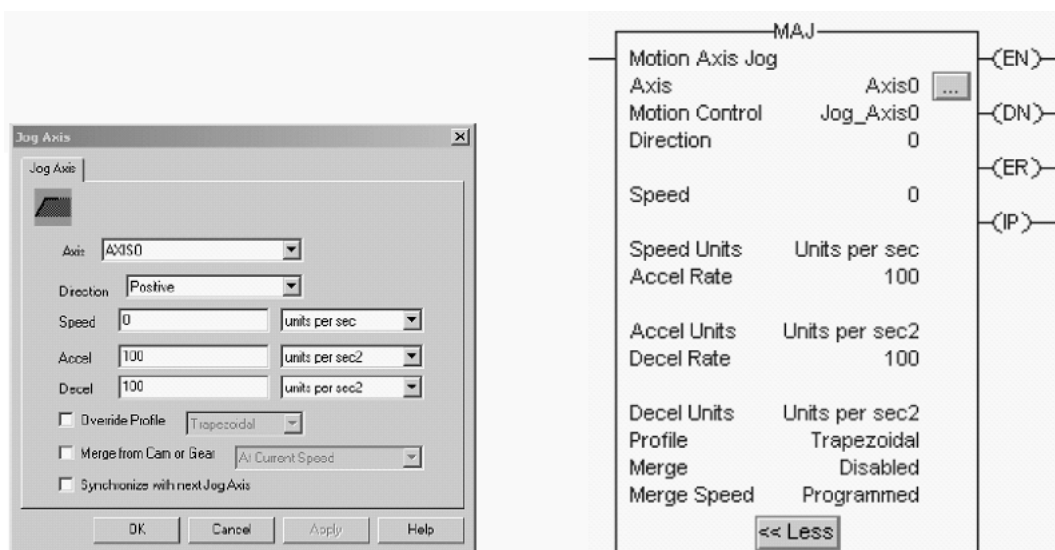
### RSLogix 5000 Code Example MCLM Instruction with Absolute Move



### Jog Axis

The Jog Axis function block and the MAJ instruction in the RSLogix 5000 software are used to jog the axis. Both instructions have the option of determining the direction and speed of the jog. The GML function block has a drop down menu selecting direction. The RSLogix 5000 MAJ motion instruction requires that you enter a numeric value into the Direction parameter, with the value of the parameter determining the direction of the jog.

### GML Jog Axis Block and RSLogix 5000 MAJ Instruction



### Comparing Jog Axis Parameters

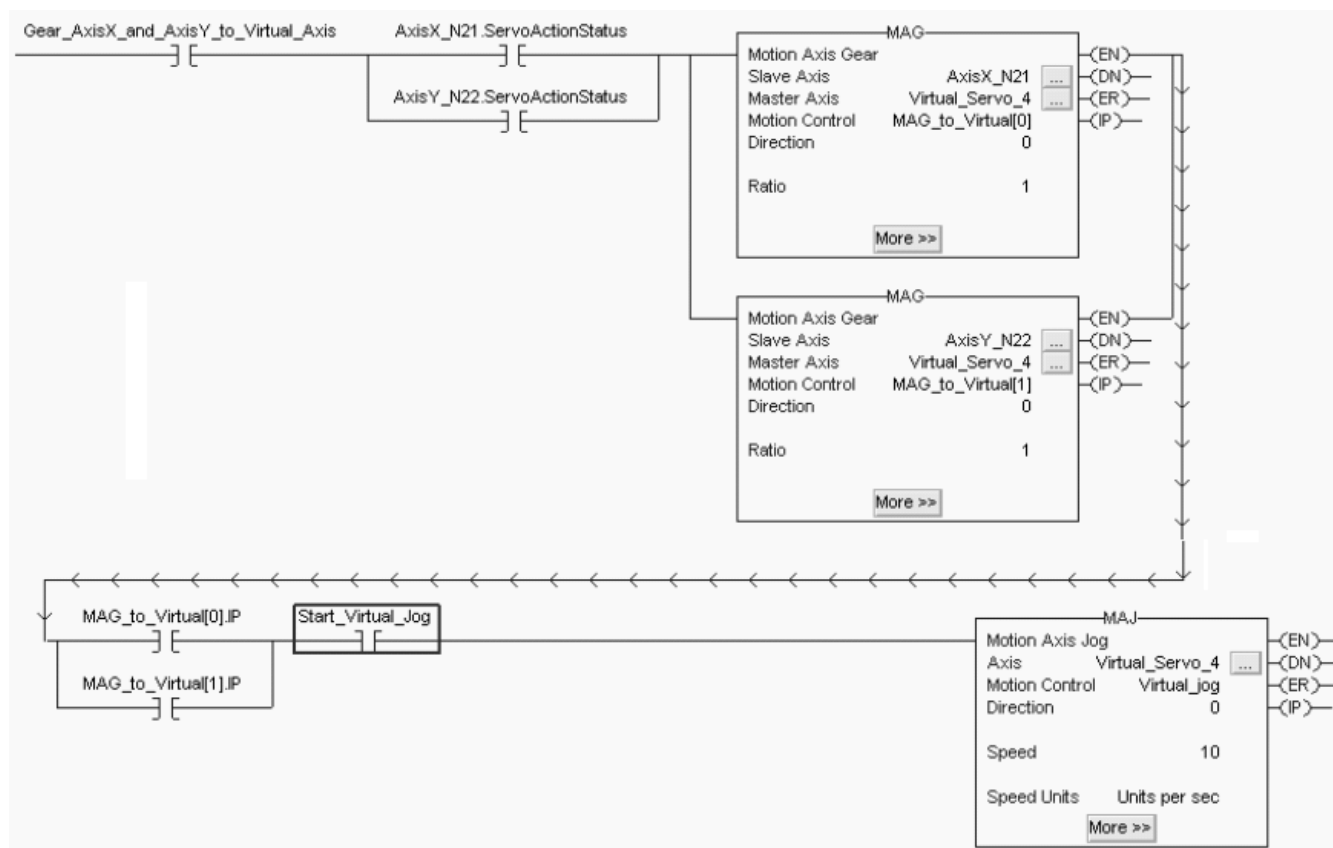
GML Software Parameter	RSLogix 5000 Software Parameter	GML Software Parameter	RSLogix 5000 Software Parameter
Axis	Axis	Decel	Decel Rate
Direction	Direction	Decel Units	Decel Units
Speed	Speed	Override Profile	Profile
Speed Units	Speed Units	Merge from CAM or Gear	Merge Enable
Accel	Accel Rate	Synchronize with next Jog Axis	N/A
Accel Units	Accel Units		

Synchronize-with-next-Jog-Axis is used in GML to run another Jog Axis block on another axis simultaneously in the motion control task. In the RSLogix 5000 MAJ instruction, this function is not available. However, if you would like two axes to jog at the same time, create a virtual axis and have both axes geared to the virtual such that they jog at the same time that the virtual axis is jogged. If you want one axis to jog at a different speed than the other, simply set the gear ratio different.

#### IMPORTANT

GML software is a sequential-based programming language. Therefore, when two axis are synchronized this way they are moved or executed at the same time. Since RSLogix 5000 software is a scan-based language, the performance or execution is not immediate, instead it is based on the Motion Group Coarse Update Rate (CUR). A general rule of thumb is to expect execution no longer than 2x the CUR. In most instances of machine performance, this will not be noticeable.

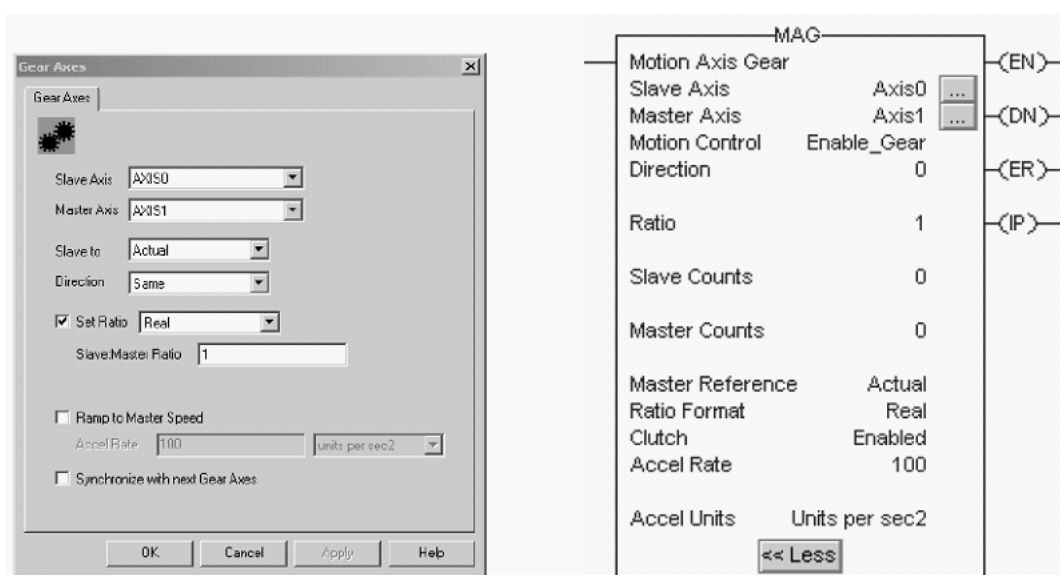
### RSLogix 5000 Code Example Using Virtual Axis to Jog Two Axes at the Same Time



## Gear Axis

The Gear Axis function block and the MAG instruction are used to enable a fixed ratio between two axes. Both instructions let you determine the master and slave axis. The same options for direction of the slave axis in relationship to the master are available in either software. Both instructions let you enter the gear ratio in either a fixed number of position units on the slave for one position unit of movement on the master, or as a ratio of feedback counts on the slave for a fixed number of feedback counts on the master.

### GML Gear Axis Block and RSLogix 5000 MAG Instruction



### Comparing Gear Axis Parameters

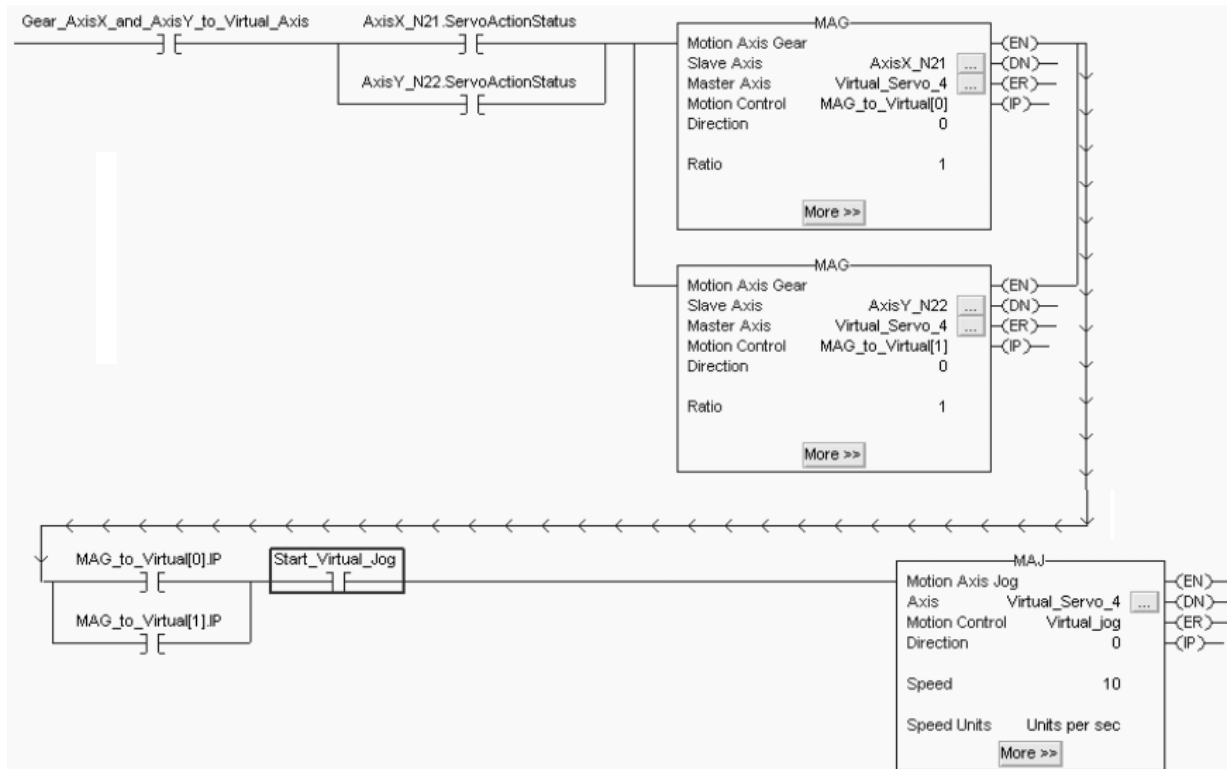
GML Software Parameter	RSLogix 5000 Software Parameter
Slave Axis	Slave Axis
Master Axis	Master Axis
Direction	Direction
Slave To	Master Reference
Set Ratio	Ratio Format
Slave/Master Ratio	Ratio/Slave/Master Counts
Ramp to Master Speed	Clutch
Accel Rate	Accel Rate/Accel Units
Synchronize with next Gear Axis	N/A

Synchronize-with-next-Gear-Axis lets you run another Gear Axis block on another axis simultaneously in the motion control task. This initiates electronic gearing on multiple axes, simultaneously.

Use simple code interaction and locking to achieve this in RSLogix 5000 software. In the previous jog example, using parallel MAG commands along with making sure the MAG instructions are in IP is basically emulating the GML function in RSLogix 5000 software.

Since your axes are not moving when you initiate the gear instructions, they act essentially the same as having them synchronize with the next gear function.

### RSLogix 5000 Code Example Using MAG Instruction Two Separate Axes Follow a Master Virtual Axis



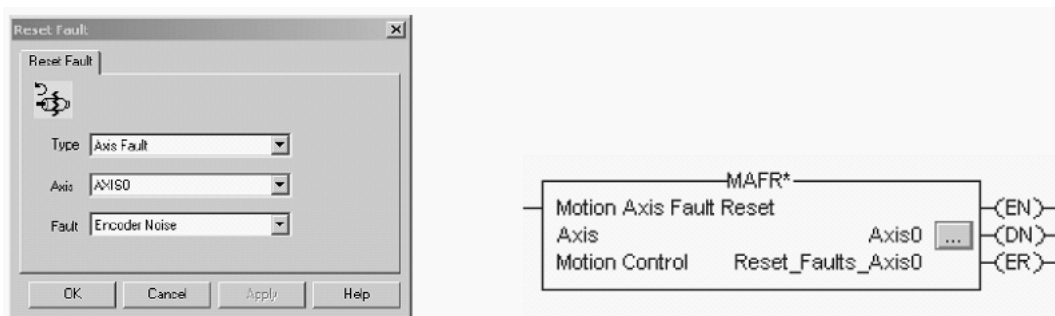


## Reset Fault

The Reset Fault block and the MAFR instruction are used to reset faults on an axis. The main functional difference between the two is that the GML function block has some additional features when compared to the Logix motion instruction. With the GML function block you can choose to clear all faults on an axis at once or reset each fault individually depending on the configuration of the block. You also have the option of resetting the 1394 drive through the fault reset block.

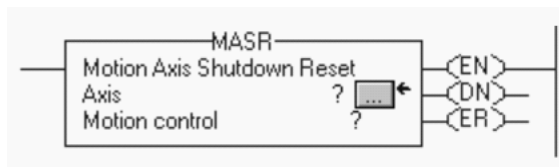
The MAFR/MASR instructions only provide the ability to reset any and all active faults on the axis at the same time. However, with RSLogix 5000 software, you can access the Axis\_Servo\_Drive tag and evaluate a fault condition and monitor it through an HMI terminal, for example, to indicate that a MAFR or MASR should be issued.

### GML Reset Fault Block and RSLogix 5000 MAFR Instruction



The MAFR instruction can clear an axis specific fault, for example Position Error fault (E19). The MASR instruction can clear, when corrected, an axis shutdown condition, for example Drive Overvoltage fault (E10).

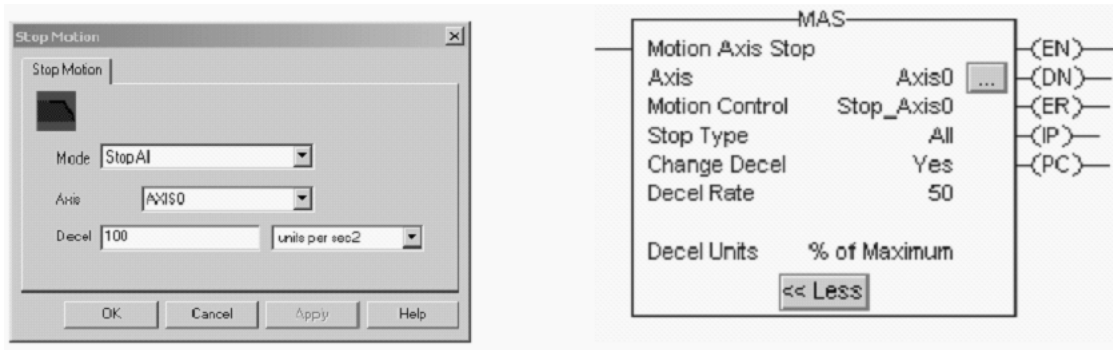
### RSLogix 5000 MASR Instruction



Stop Motion

The Stop Motion function block and MAS instruction are used to bring the axis to a controlled stop. Both instructions give you the option of stopping all motion on an axis or stopping a particular type of motion such as a jog, move, gear, home, or cam. The MAS instruction lets you set a deceleration rate by setting the Change Decel parameter to Yes and then putting the desired rate of deceleration and the units of the deceleration in the subsequent parameters. If the Change Decel parameter is set to No, the deceleration limit, set in the Axis Properties dialog, Dynamics tab, is used. The percent of maximum is also a percent of maximum deceleration. You can also find this in the Axis Properties dialog, Dynamics tab.

GML Stop Motion Block and RSLogix 5000 MAS Instruction



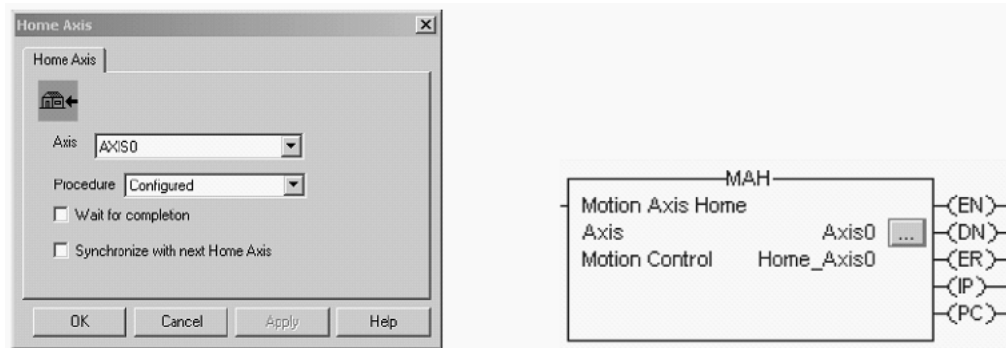
Comparing Stop Motion Parameters

GML Software Parameter	RSLogix 5000 Software Parameter
Mode	Stop Type
Axis	Axis
Decel	Decel

## Home Axis

The Home Axis function block and the MAH instruction are used to home an axis and define the actual position of the axis upon completion of the procedure. Both instructions execute the homing procedure as configured in the axis properties dialog of the axis.

### GML Home Axis Block and RSLogix 5000 MAH Instruction



You can review the configuration of the homing procedure in GML software by clicking the Configure/Axis Use/AXISx (the axis whose homing configuration you wish to review).

### GML Configure Options



### GML Configure Axis Use (Homing Tab)

The screenshot shows the 'Configure Axis Use - AXIS0' dialog box with the 'Homing' tab selected. The 'Position (INCH)' is set to 0. The 'Procedure' is set to 'Active'. Under the 'Active' section, the 'Limit Switch' is set to 'Normally Open' and 'Use Marker' is checked. The 'Direction' is set to 'Positive'. The 'Homing Speed (INCH/Second)' is set to 1, and the 'Return Speed (INCH/Second)' is set to 0.1. Under the 'Absolute-MV' section, the 'Assembly For #' is set to 'Custom' and the 'Turns Range' is set to 256. The dialog has 'OK', 'Cancel', 'Apply', and 'Help' buttons at the bottom.

### RSLogix 5000 Axis Properties (Homing Tab)

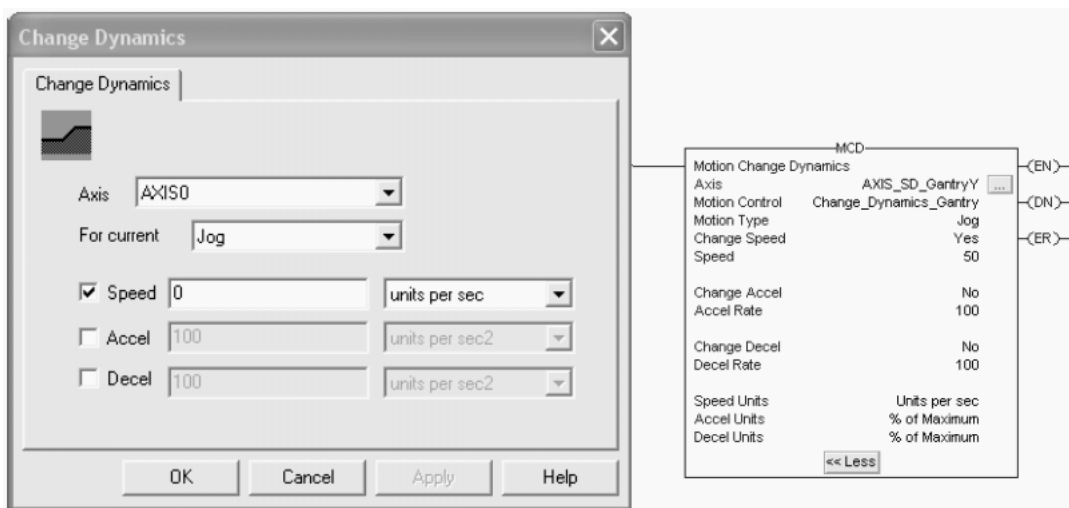
The screenshot shows the 'Axis Properties - AXIS\_SD\_AccumulatorSlide' dialog box with the 'Homing' tab selected. The 'Mode' is set to 'Active'. The 'Position' is set to 0.0 mm, and the 'Offset' is set to 0.0 mm. The 'Sequence' is set to 'Switch-Marker'. The 'Limit Switch - Normally' is set to 'Closed'. Under the 'Active Home Sequence Group', the 'Direction' is set to 'Forward Bi-directional', 'Torque Level' is set to 0.0 % Continuous Torque, 'Speed' is set to 100.0 mm/s, and 'Return Speed' is set to 14.0 mm/s. The dialog has 'OK', 'Cancel', 'Apply', and 'Help' buttons at the bottom.

RSLogix 5000 software, version 16, added the ability to home to a torque level or torque level-marker, if required, and provides more flexibility in the homing functions. There are multiple active homing directions, for example bi-directional and uni-directional homing. Absolute mode, immediate sequence is used for retaining absolute positioning of an axis when power is removed. These functions are not available in GML software.

## Change Dynamics

The Change Dynamics function block and the MCD instruction are used to change speed, accelerations, and decelerations for existing move and jog functions.

### GML Change Dynamics Block and RSLogix 5000 MCD Instruction



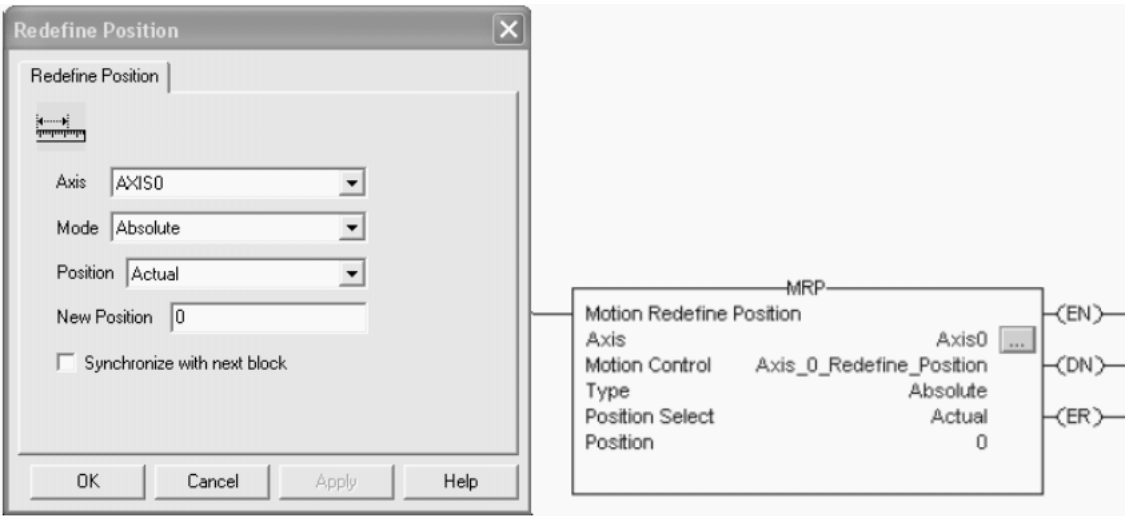
### Comparing Change Dynamics Parameters

GML Software Parameter	RSLogix 5000 Software Parameter
Axis	Axis
For Current	Motion Type
Speed	Change Speed/Speed Units
Accel	Change Accel/Accel Rate/Accel Units
Decel	Change Decel/Decel Rate/Decel Units

*Redefine Position*

The Redefine Position function block and the MRP instruction are used to set the actual or command position of the selected axis to the commanded absolute position.

**GML Redefine Position Block and RSLogix 5000 MRP Instruction**



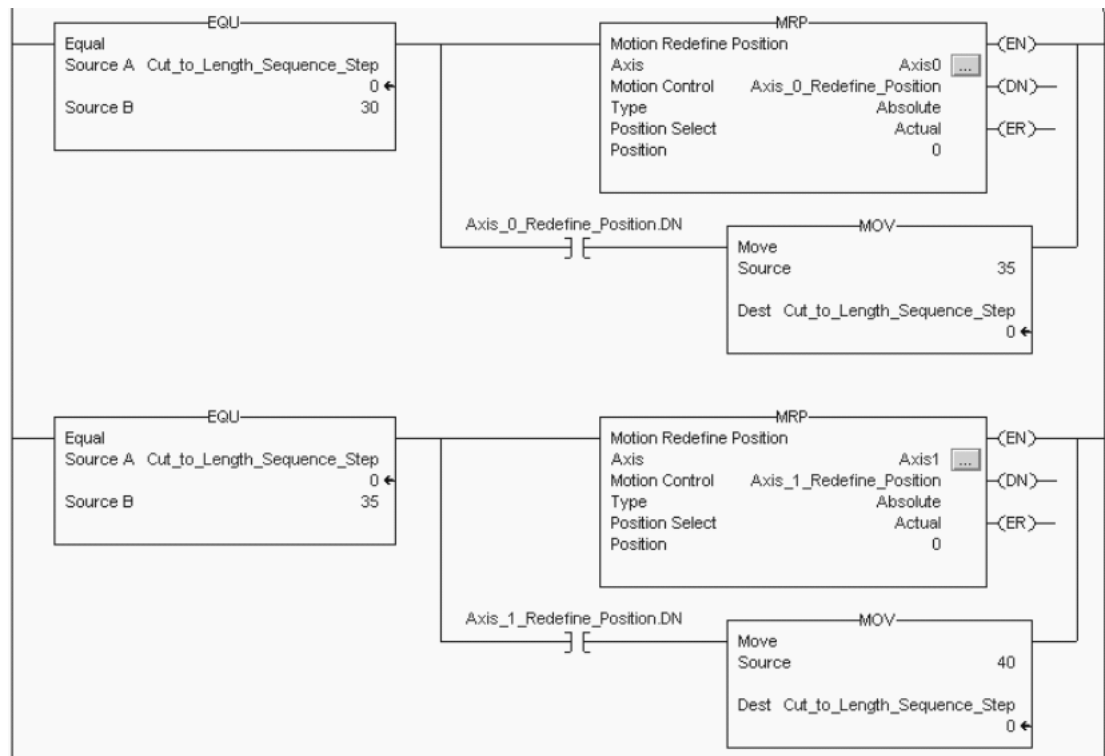
**Comparing Redefine Position Parameters**

GML Software Parameter	RSLogix 5000 Software Parameter
Axis	Axis
Mode	Type
Position	Position Select
New Position	Position
Synchronize with next block	N/A

In GML software, the Synchronize-with-next-block function lets you simultaneously redefine the position of multiple axes. The MRP instruction in RSLogix 5000 software does not have this specific function, but has software code with parallel MRP instructions that you can use to closely simulate this function. Refer to the RSLogix 5000 code example on page 95, for an example.

For more information and cautions for the use of the MRP instruction, refer to the Logix5000 Controllers Motion Instructions Reference Manual, publication [1756-RM007](#). For example, use absolute mode only if the selected axis is stationary.

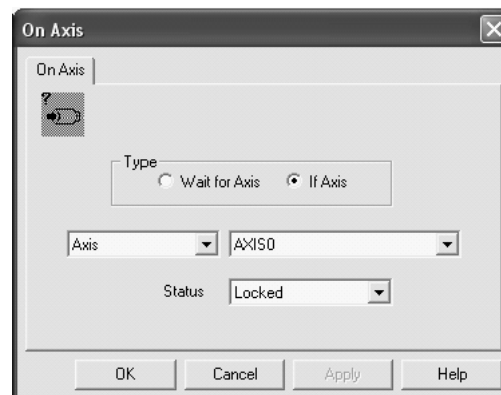
### RSLogix 5000 Code Example Using the MRP Instruction for Two Axis Position Definition



### *On Axis, If Axis Fault, and Show Axis Status*

The On Axis, If Axis Fault, and Show Axis Status function blocks program the drive to proceed/not proceed if an axis status is known.

### GML On Axis Block



Wait for Axis is used to determine the axis status and program flow. If Axis is used to move to the next GML function block, if that specific axis status is true. GML software is a sequential-based language so it can hold a task until this actual Axis status is true. RSLogix 5000 software is scan-based so it is not possible to stop the scan, but it is

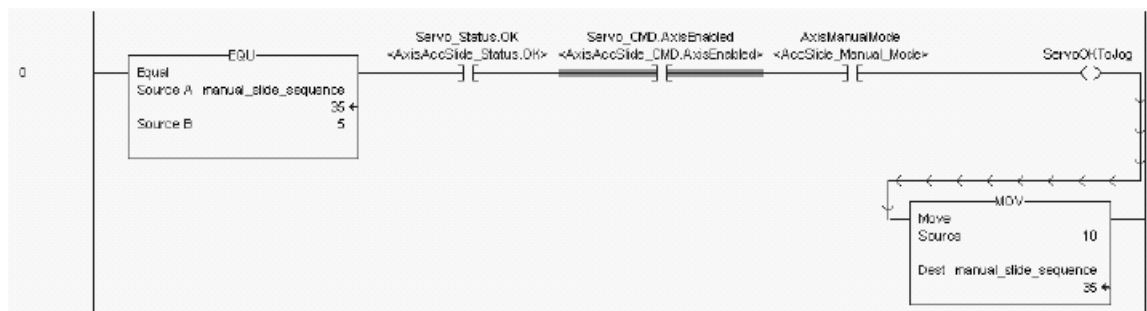
possible to use AFI instructions to make the rung always false or to use interlocking of code to determine if a next step should happen or not.

When using RSLogix 5000 software, an `AXIS_SERVO_DRIVE` instruction is created for every axis on the SERCOS ring. The tag structure automatically creates many associated tags that give the status of the axis, for example, if the drive is enabled or if the drive has faulted.

It is possible to use the tags associated with the `Axis_Servo_Drive` structure to direct program execution with simple code. For example, Examine On (XIO) or Examine Off (XIC) instructions along with the `Axis_Servo_Drive` structure allows program flow based on axis status.

In this ladder diagram, a User Defined Tag (UDT) is created for a Servo Status. If the Servo is OK, this XIO closes. If the Axis is enabled, the next XIO closes. If the mode is changed from automatic to manual, the next XIO closes. If all three are true, the `ServoOkToJog` output turns on and work wherever it is referenced. The first two XIO tags are referenced to the servo axis through the `AXIS_SERVO_DRIVE` tag structure.

### RSLogix 5000 Code Example Using Tags for Axis Status

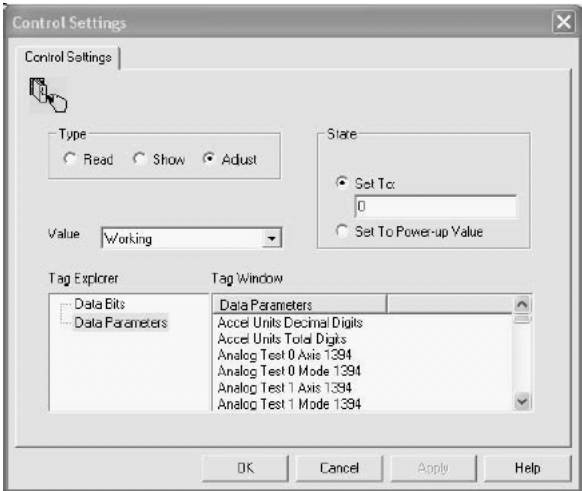


### *Control Settings, Motion Settings, Show Axis Position*

The Control Settings, Motion Settings, and Show Axis Position function blocks, and the SSV/GSV instructions let you program the drive to change or adjust power-up or working control values, for example, maximum axis speed and acceleration. They are also used to send axis position or registration data, for example, to the HMI terminal.



GML Control Settings Block

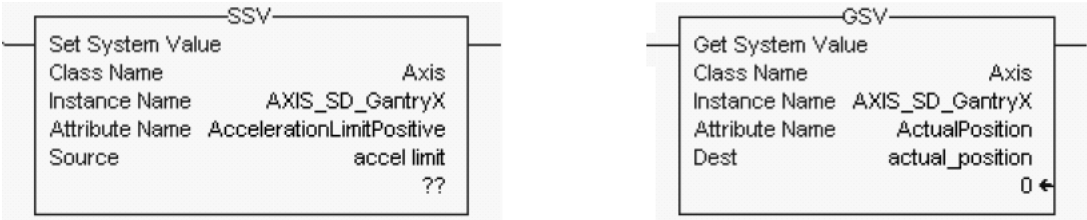


In RSLogix 5000 software, Set System Value (SSV) instruction is used to adjust an axis property or configuration, for example, an Axis\_Servo\_Drive acceleration limit. The Get System Value (GSV) instruction is used to view an axis property or configuration on an HMI terminal or somewhere else in the program.

**IMPORTANT**

Use Set System Value (SSV) instructions sparingly. If many are needed, stagger them in rungs (with state logic) and wait for the AXIS\_SERVO\_DRIVE configuration update in process to be off before executing another SSV instruction.

RSLogix 5000 SSV and GSV Instructions



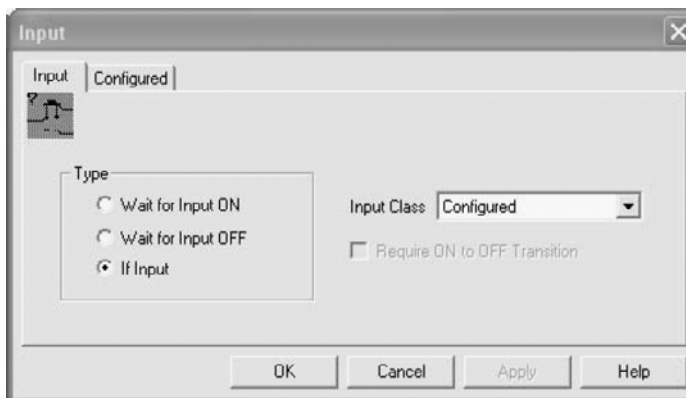
Comparing Control Settings Parameters

GML Software Parameter	RSLogix 5000 Software Parameter
Type	Class Name
Value	Dest
State	Attribute Name
Tag	Dest

### *Input, Show Input Status, Output*

The Input, Show Input Status, and Output function blocks, and the Bit Control instructions let you program the drive to control program flow with a dedicated, configured, or miscellaneous input. They are also used for turning on a general purpose, SLC, RIO, AxisLink, or Flex I/O discrete output.

#### **GML Input Block (configured)**



#### **TIP**

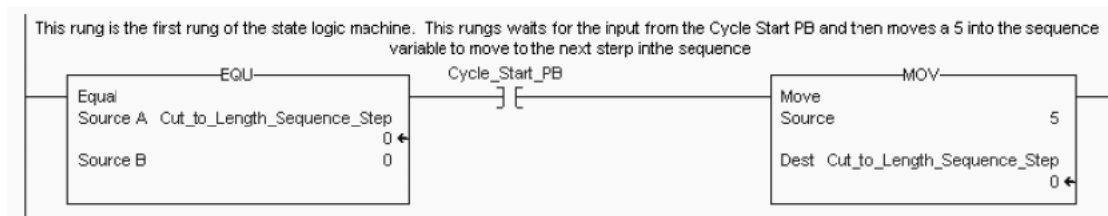
A marker state, dedicated input, as used in GML software is not available in RSLogix 5000 software.

#### **GML Input Block (dedicated)**



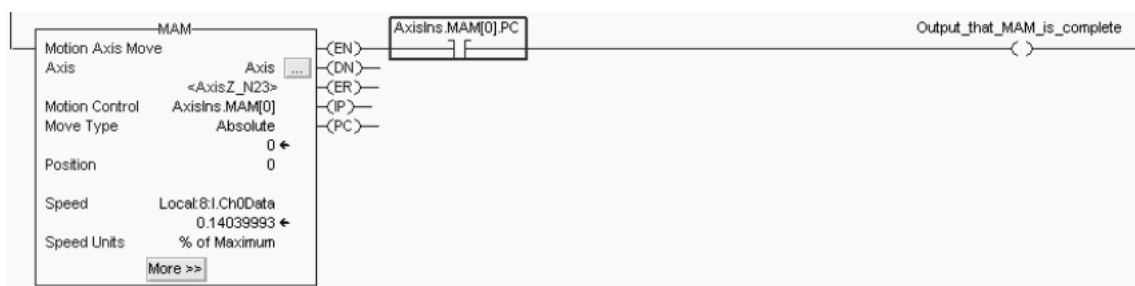
This is the first rung of the state logic machine. This rung waits for the input from the Cycle Start PB, then moves a 5 into the sequence variable to move to the next step in the Cycle\_Start\_PB sequence.

### RSLogix 5000 Code Example Using BIT Control



You can use the BIT expressions such as Examine On (XIO), or Examine Off (XIC), for inputs used in the program flow. You can use OTE Output Energized, as an output to be energized based on program sequence.

### RSLogix 5000 Code Example MAM Instruction PC Bit Turns Output On



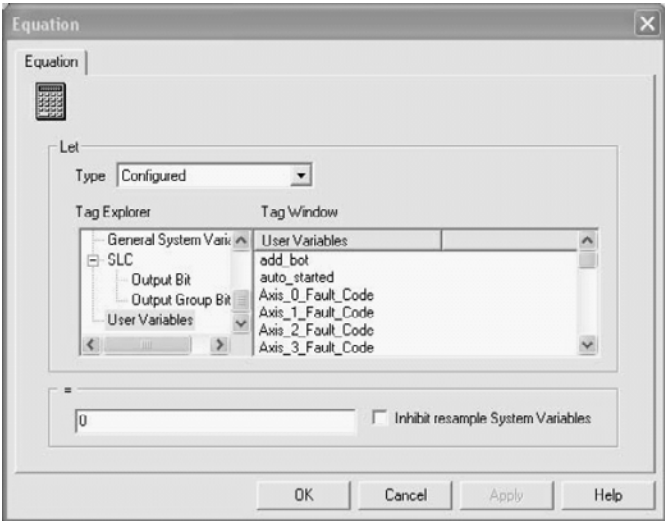
The Input function block is similar to BIT Control in RSLogix 5000 software. However, it should be noted that the input in GML software can interrupt and hold the program until the input is active or not. In RSLogix 5000 software this is purely a scan based type of input and how it reacts is determined by the program.

In addition, the Show Program Status block is used in GML software to show the task or program being run. It also indicates a runtime fault. Use the State Logix code in between the EQU and the MOV block. This makes sure you that if the program were to fault or not flow properly, you can identify within a specific rung where the error occurred.

*On Expression and Equation*

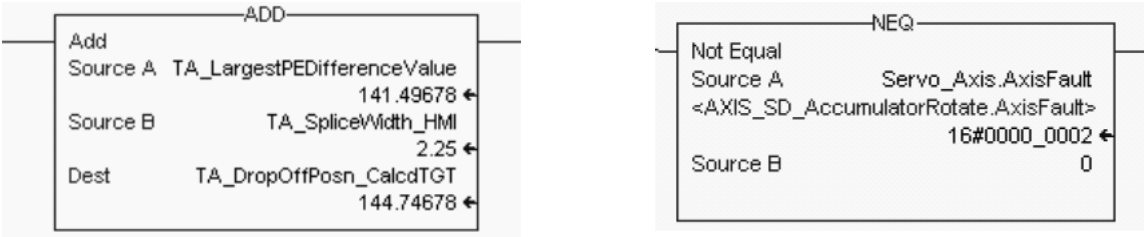
The On Expression and Equation function blocks, and the Compare/Compute/Math instruction folders let you program the drive to configure a mathematical expression or assign a value, for example, to a variable or cam profile points.

**GML Equation Block**



The Compare instruction folder lets you create a Compare-to-a-Value using, for example, NEQ or EQU instructions. Use the Compute/Math folder to use ADD or similar math functions.

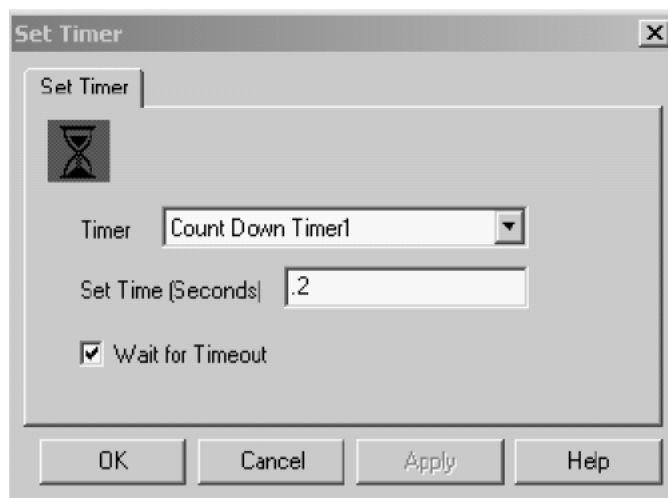
**RSLogix 5000 ADD and NEQ Instructions**



### *On Timeout and Set Timer*

You can use the On Timeout and Set Timer function blocks, and the Timer/Counter folders as countdown timers. The On Timeout and Set Timer function blocks are used to pause the GML software program until the time has elapsed by checking the Wait for Timeout block.

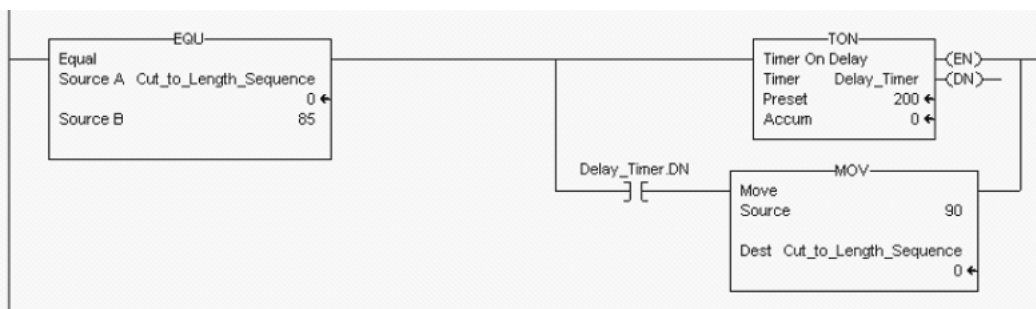
#### **GML Set Timer Block**



RSLogix 5000 software uses a TON instruction to duplicate this step and monitor the DN bit of the timer to determine when the timer has timed out before moving on to the next step in the sequence.

In this code example, the Delay\_Timer.DN tag completes and the ladder diagram moves to the Cut\_to\_Length\_Sequence value of 90.

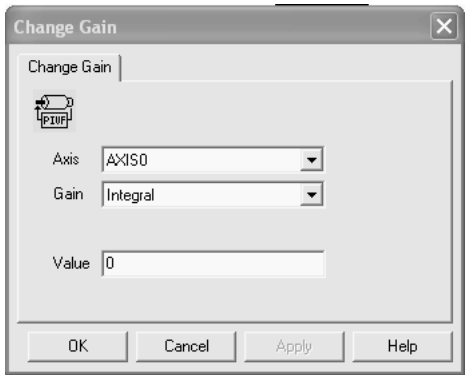
#### **RSLogix 5000 Code Example TON Instructions**



*Change Gain*

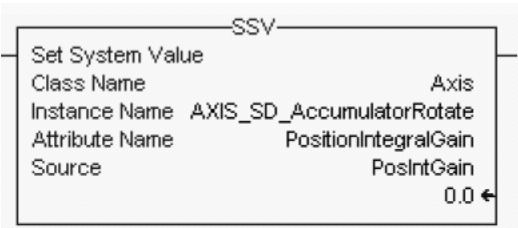
The Change Gain function block in GML software lets you change the axis gains at any point in the program without affecting the power-up values.

**GML Change Gain Block**



In RSLogix 5000 software, the Set System Value (SSV) instruction is best to adjust an axis property like, for example, a tuning function.

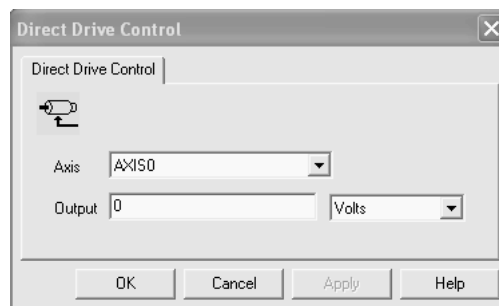
**RSLogix 5000 SSV Instruction**



### *Direct Drive Control*

The Direct Drive Control function block in GML software is not applicable to conversion with the Kinetix 6000 drive. In RSLogix 5000 software the MDO instruction is used, most likely, in an analog application with the 1756-M02AE or 1756-M02AS motion module.

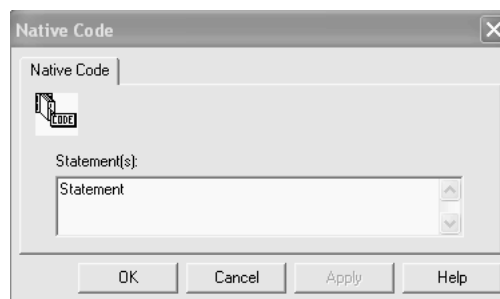
#### **GML Direct Drive Control Block**



### *Native Code*

The Native Code function block lets you write base ICODE instructions in GML software. This is not applicable in RSLogix 5000 software.

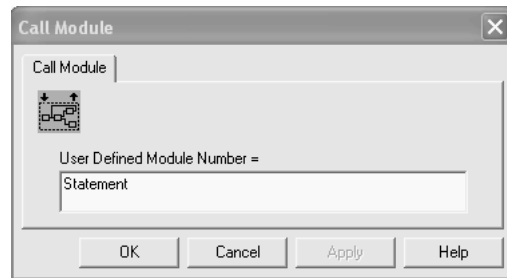
#### **GML Native Code Block**



## Call Module

The Call Module function block in GML software lets you call and execute for an external module that is a subroutine for the existing GML program.

### GML Call Module Block

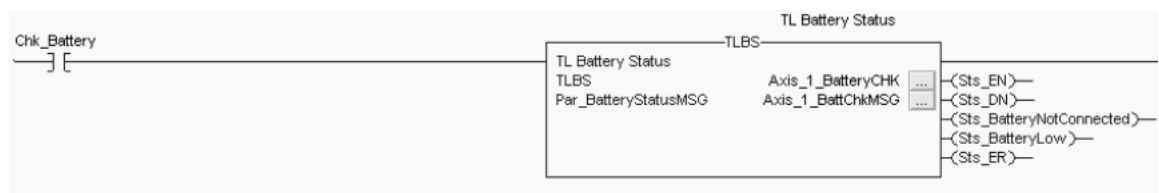


Use the Program Control Folder in RSLogix 5000 software to move to another part of the program. For example, the Jump To Subroutine (JSR) instruction can be used to jump to a subroutine in the program.

The Add On Instruction (AOI) in RSLogix 5000 software is used to create your own subroutine for instructions. For example, it is possible to create an AOI routine for fault reset, enabling, and homing an axis. This eliminates having to create the ladder code but it can make troubleshooting the program a bit more difficult.

The RSLogix 5000 software rung below is used with an AOI instruction. When Chk Battery is requested, the rung executes the AOI instruction, which checks the TL-Series motor (with high-resolution feedback) backup battery that maintains absolute position. Either the battery is low (minimum level), completely discharged, or not connected properly.

### RSLogix 5000 Code Example AOI Instruction



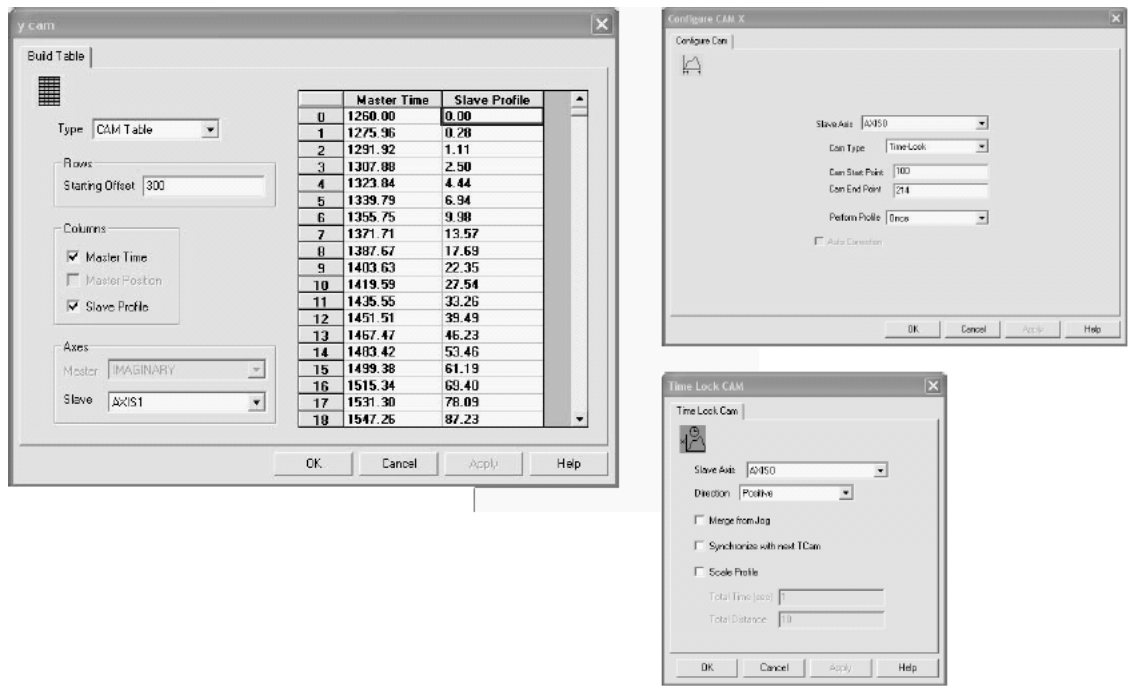


Build Table, Configure CAM, and Time Lock CAM

GML software uses the Build Table, Configure CAM and Time Lock CAM function blocks to perform a Time Master to slave position type function.

RSLogix 5000 software uses the MCCP and MATC instructions to build a variable or standard Time-based Cam that performs the same function.

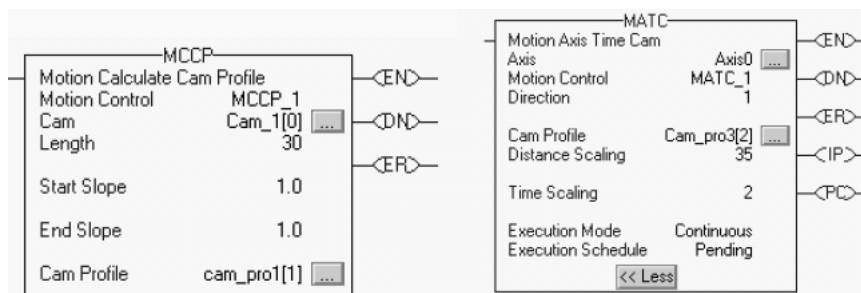
GML Build Table/Configure Cam/Time Lock CAM Blocks



To properly execute a Time Lock Cam function block in GML software, the Build Table and Configure Cam function blocks are used to set up and execute the Cam function. The Build Table function block sets up the cam points based on the master time versus slave time profile. The Build Table block can also be setup as a variable array used in GML software. The Configure Cam block typically sets up the reference for the Time Lock Cam function. Use the Time Lock Cam block to set up a non-linear motion profile for a slave axis with respect to a time base and then execute the specific Time Lock Cam in the required program area.

RSLogix 5000 software combines these three blocks into one MATC instruction. If the cam profile is not specifically known, is in a data table, or may change during the process due to the HMI terminal or other interface, the MCCP makes these calculations, creates the cam profile, and works with the MATC instruction to execute the function.

## RSLogix 5000 MCCP/MATC Instructions



### Comparing Build Table Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MCCP
Type	Cam Profile exclusive
Row Offset	N/A
Columns Master Time	Cam
Master Position	N/A
Slave Profile	Cam
Axes Master	N/A
Slave	Cam Profile exclusive
Table	Cam

### Comparing Configure CAM Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MATC
Slave Axis	Axis
Cam Type	MATC exclusive instruction
Cam Start Point	Tag array, set in Cam profile
Cam End Point	Tag array, set in Cam profile
Perform Profile	Execution Mode

### Comparing Time Lock CAM Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MATC
Slave Axis	Axis
Direction	Direction
Merge from Jog	N/A
Synchronize with next TCAM	N/A
Scale Profile	
Total Time	Time Scaling
Total Distance	Distance Scaling

The Merge-from-Job and synchronize-with-next-TCAM parameters are not supported in the MATC instruction.

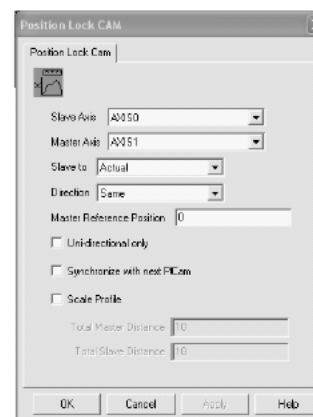
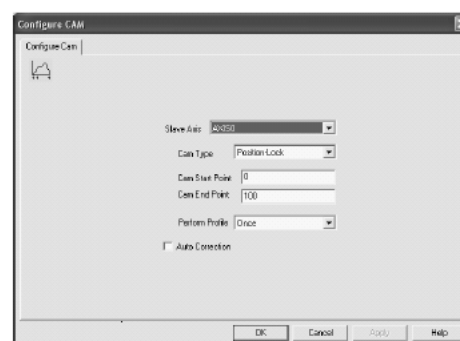
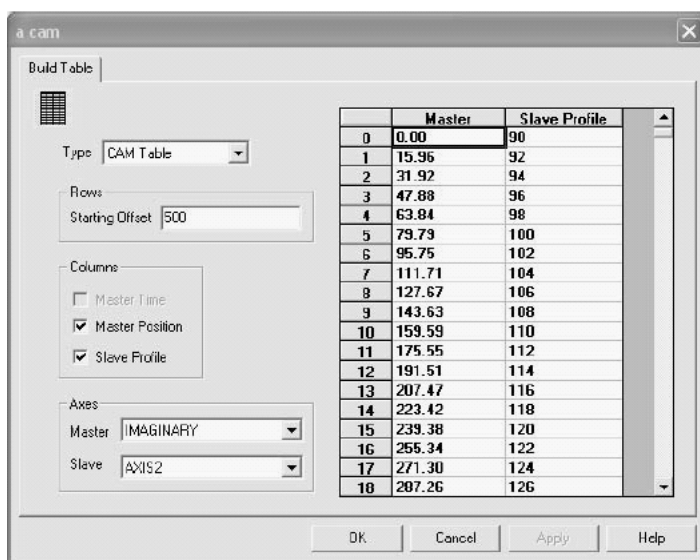
The most effective way of blending or moving into an MATC instruction is to create an initial MATC instruction moving the slave per unit of time at one speed and then using a pending MATC instruction to smoothly move the slave to another profile.

The most effective way of having multiple axes follow a master time schedule is to use a virtual axis and MAPC instruction to command the slave axis to the master axis such that the profile can emulate a time-versus-slave position profile. Or, perhaps use of the MCLM and MCCM functions for coordination of multiple axes.

### *Build Table, Configure CAM, Position Lock CAM*

Use the Build Table, Configure CAM, and Position Lock CAM function blocks, and the MCCP/MAPC instructions to build position cam profiles and arrays of user variables. Construct a table of values by entering a value or expression for each item in the table or by copying points from a spreadsheet.

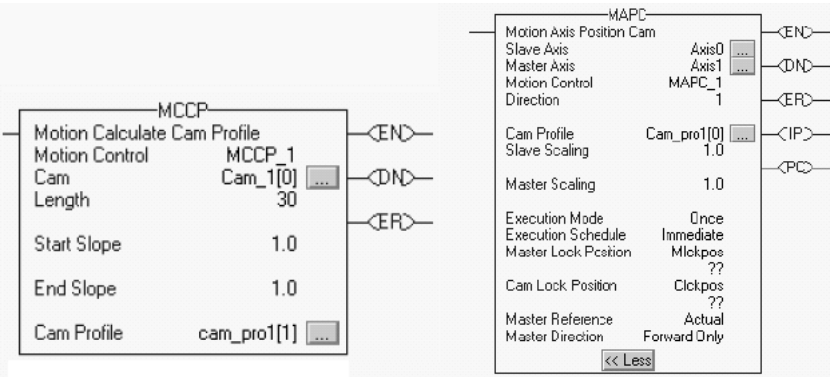
### **GML Build Table/Configure CAM/Position Lock CAM Blocks**



To properly execute a Position Lock Cam function block in GML software, the Build Table and Configure Cam function blocks are used to set up and execute the Cam function. The Build Table function block sets up the cam points based on the master position versus slave profile. The Build Table block can also be setup as a variable array to be used in GML software. The Configure Cam block typically sets up the reference for the Position Lock Cam. The Position Lock Cam lets you set up a non-linear motion profile for a slave axis with respect to a physical, encoder only, virtual, or imaginary axis.

RSLogix 5000 software combines these three blocks into one MAPC instruction. If the cam profile is not specifically known, is in a data table, or may change during the process due to the HMI terminal or other interface, the MCCP makes these calculations, creates the cam profile, and works with the MAPC instruction to execute the function.

RSLogix 5000 MCCP/MAPC Instructions



Comparing Build Table Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MCCP
Type	Cam Profile exclusive
Row Offset	N/A
Columns Master Time	N/A
Master Position	Cam
Slave Profile	Cam
Axes Master	In MAPC instruction
Slave	Cam Profile exclusive
Table	Cam

### Comparing Configure CAM Parameters

<b>GML Software Parameter</b>	<b>RSLogix 5000 Software Parameter MAPC</b>
Slave Axis	Slave Axis
Cam Type	MAPC exclusive instruction
Cam Start Point	Tag array, set in Cam profile
Cam End Point	Tag array, set in Cam profile
Perform Profile	Execution Mode
Auto Correction	N/A

### Comparing Position Lock CAM Parameters

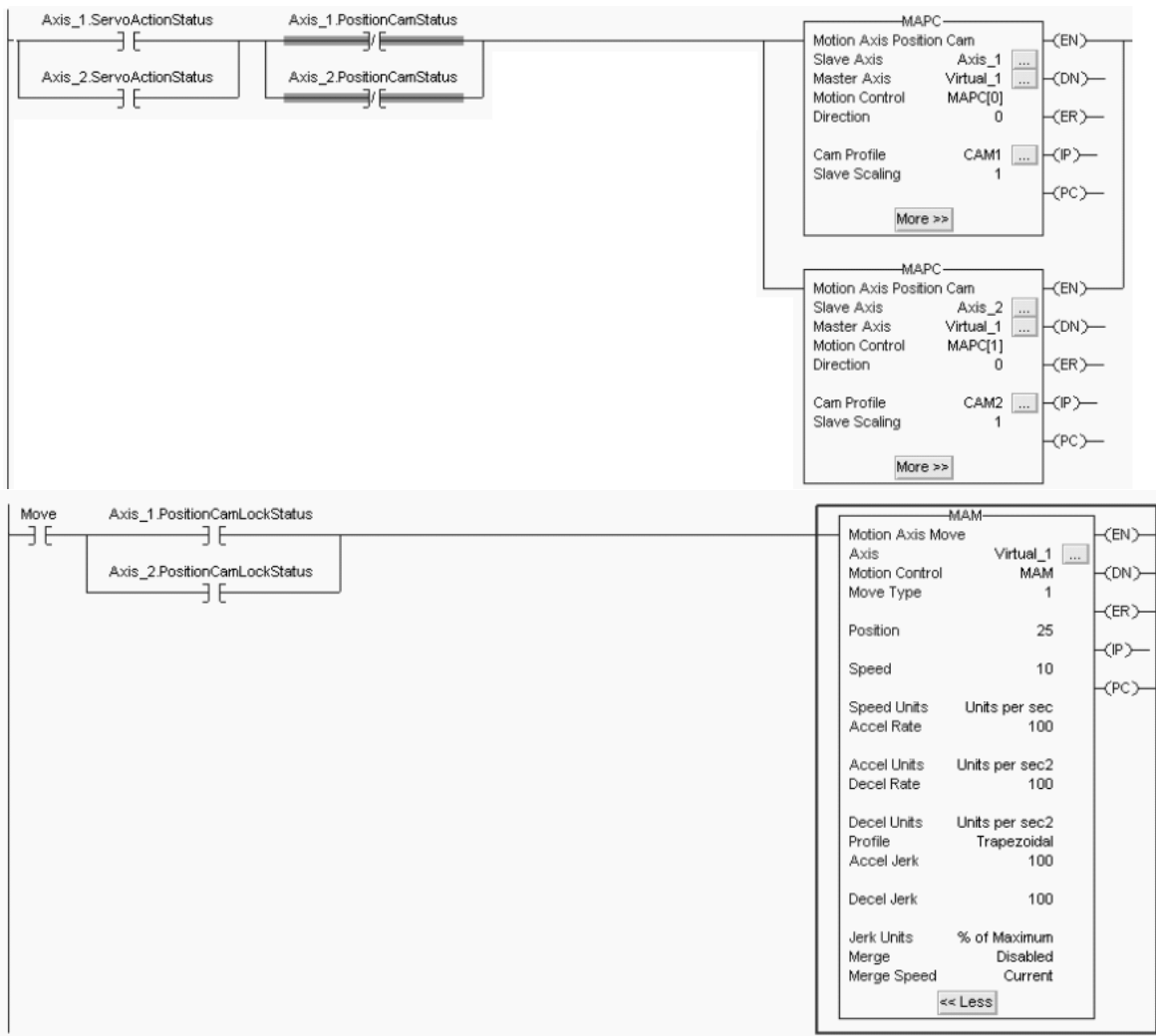
<b>GML Software Parameter</b>	<b>RSLogix 5000 Software Parameter MAPC</b>
Slave Axis	Slave Axis
Master Axis	Master Axis
Slave To	Master Reference
Direction	Direction
Master Reference Direction	Master Lock Position
Uni-directional Only	Master Direction
Synchronize with next Pcam	N/A
Scale Profile	
Total Master Distance	Master Scaling
Total Slave Distance	Slave Scaling

Auto Correction and Synchronize with next Pcam functions are not available in RSLogix 5000 (MAPC/MCCP) instructions.

In GML software, the Auto Correction parameter, in conjunction with Auto Registration, is used to continuously re-synchronize position-lock cam master and slave axes to registration marks. Continuous re-synchronization is necessary when an axis slips or if the material, upon which the registration marks are printed, is not consistent. Auto Correction is not standard in the MAPC instruction. Code needs to be written in RSLogix 5000 software to emulate such a function.

The Synchronize-with-next-Pcam parameter lets you synchronize two Position Lock Cam profiles so that they start at the same time. This is beneficial in using two different slave axes cammed to the same master. In RSLogix 5000 software, this can be accomplished by initializing two MAPC instructions that are slaved to a master virtual axis (refer to the example on page 110). You can move the virtual axis using an MAJ or MAM instruction and both corresponding slave axes will start at the same time (based on the configuration).

RSLogix 5000 Code Example  
Using MAPC Instructions to Synchronize Two Slave Axes



## *Interpolate Axes*

This GML block lets you use a group of two or more axes in a specified absolute/incremental distance, along a linear, circular, or helical path at a specific speed/accel/decel rate using a given motion profile. The types listed are linear, radius arc, intermediate arc, and helical.

### **GML Interpolate Axes Block**

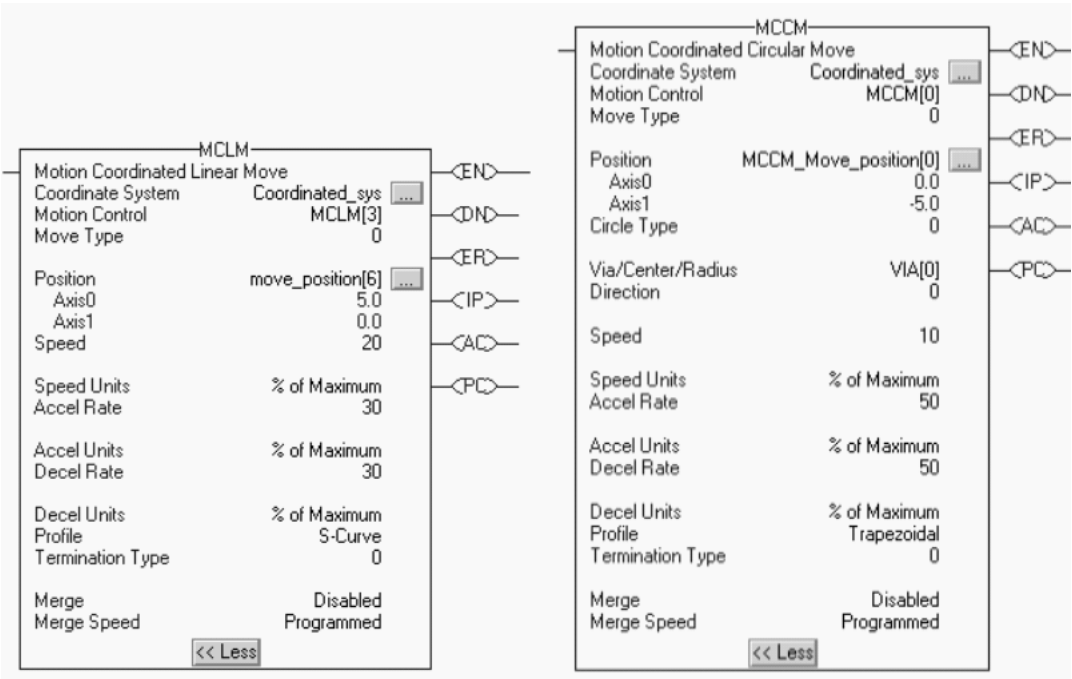
The screenshot shows the 'Interpolate Axes' dialog box. It contains the following fields and controls:

- Type:** Linear (dropdown menu)
- Interpolator:** 0 (dropdown menu)
- Profile:** Trapezoidal (dropdown menu)
- Mode:** Absolute (dropdown menu)
- Time (sec.):** 0 (text field, preceded by a checkbox)
- Axes:** 2 Axes (dropdown menu)
- Destination Table:**

	Destination
X	Ax1S0 0
Y	Ax1S1 0
- Speed:** 0 (text field) with a unit dropdown (units per sec)
- Accel / Decel:** 100 (text field) with a unit dropdown (units per sec2)
- Checkboxes:**
  - ☐ Merge from Previous Segment
  - ☐ Wait for Completion
- Buttons:** OK, Cancel, Apply, Help

In RSLogix 5000 software, the MCLM and MCCM instruction can simulate the linear and radius/intermediate arc, but cannot make the helical interpolation moves.

RSLogix 5000 MCLM/MCCM Instructions



Comparing Interpolate Axes Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MCLM or MCCM
Type	Either MCLM or MCCM instruction
Interpolator	N/A
Profile	Profile
Mode	Move type
Time	N/A
Number of axes	
X axis destination	Position axis 0
Y axis destination	Position axis 1
Merge from previous segment	Blend function
Wait for completion	N/A
Speed	Speed
Accel/Decel	Accel rate, decel rate

There are four functions or items to discuss in the transition of the GML Interpolator to the RSLogix 5000 instruction set.

First, GML software has the ability to use two interpolators to execute two separate interpolated moves at the same time. There are no limitations to the number of interpolations that may be executing at one time. However, the use of complex motion instructions can affect



the processor execution time. Too many motion executions at one time can lead to SERCOS ring drops or other functional issues.

Second, GML software supports helical interpolation. RSLogix 5000 software MCCM and MCLM motion instructions do not have this specific embedded function.

The proposed program code would be to use a virtual axis as the master and have Axis Y, Axis X and Axis Z all position cammed to it. Axis X and Axis Y would be setup to execute a circularly profile. Axis Z will then be a linear profile. Therefore, when you move or jog the virtual axis, all three axis perform a coordinated, helical movement.

Third, merge from previous segment. A MCLM or MCCM instruction does not have a motion checkbox for merging from a previous MCLM or MCCM instruction.

To blend from one MCLM to the next, use this approach or fine tune it to your application.

#### RSLogix 5000 Code Example for Blended Instructions

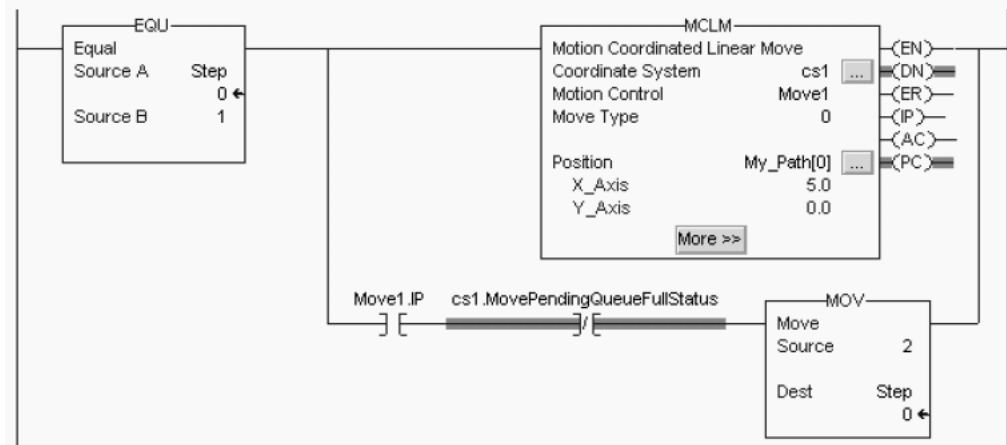
If Step = 1 then

Move1 starts and moves the axes to a position of 5, 0

And once Move1 is in process

And there is room to queue another move

Step = 2



### RSLogix 5000 Code Example for Blended Instructions (continued)

If Step = 2 then

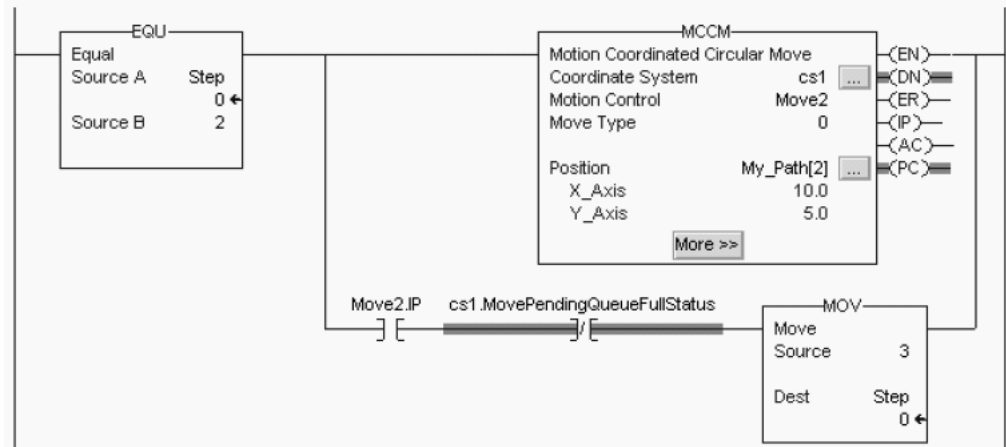
Move1 is already happening.

Move2 goes into the queue and waits for Move1 to complete.

When Move1 is complete, Move2 moves the axes to a position of 10, 5.

And once Move2 is in process and there is room in the queue,

Step = 3



When an instruction completes, it is removed from the queue and there is space for another instruction to enter the queue. Both bits always have the same value because you can queue only one pending instruction at a time. If the application requires several instructions to be executed in sequence, the bits are set using these parameters.

Fourth, a Wait for Completion routine in a MCCM or MCLM instruction is not supported in RSLogix 5000 software.

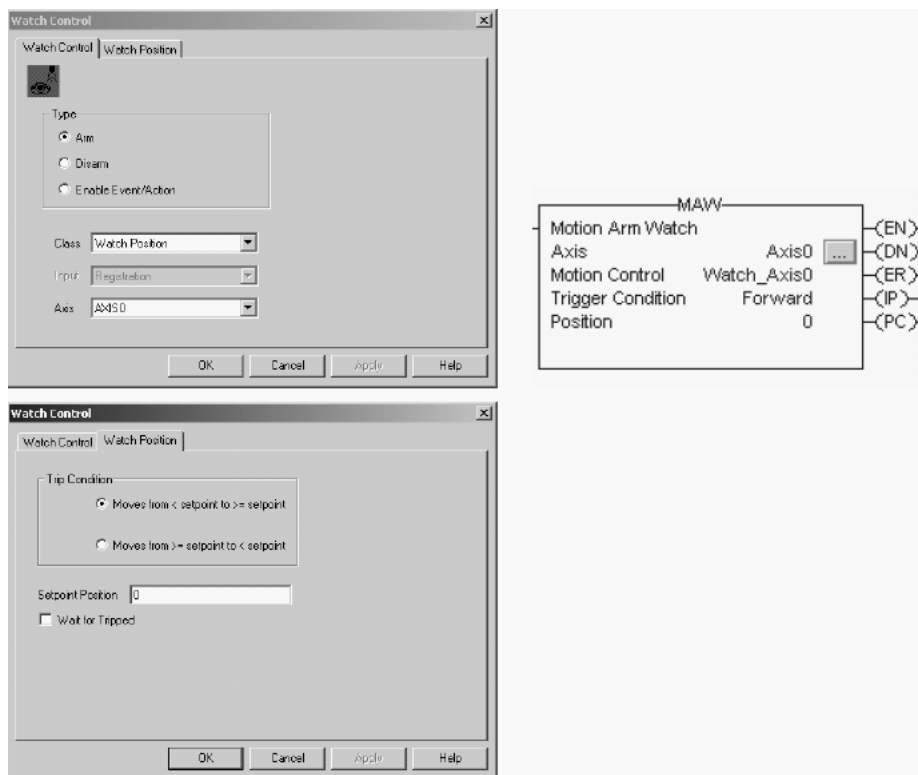
Use the PC bit of the MCLM or MCCM instruction in the application code before an instruction you want to execute. This way, the specific MCCM/MCLM instruction must complete before the next instruction can occur.

## Watch Position and On Watch

GML software uses the Watch Control and On Watch blocks to:

- arm a Watch Position event to occur when the selected axis reaches the setpoint position. The Wait for Tripped selection in this block or the On Watch block can be used to pause a specific task until the event occurs. Otherwise, the On Watch block can be used for proper program flow if the event occurs or not.
- disarm a previously armed Watch Position event that has not yet occurred.
- arm a Registration event to store the actual positions of all physical and virtual axes on the specified edge of a dedicated, high-speed registration input.
- disarm a Registration event, which has not yet occurred.
- enable a Watch Position event to occur in response to a setpoint position event.
- enable a Dedicated or Configured input event to occur in response to a setpoint position event.
- disarm an event or action enabled by a previous Watch Control block, which has not yet occurred.

### Watch Control Block and Motion Axis Watch (MAW) Instruction



### Comparing Motion Axis Watch Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MAW
Axis	Axis
Move from < setpoint to $\geq$ setpoint	Trigger condition - Forward
Move from > setpoint to $\leq$ setpoint	Trigger condition - Reverse
Setpoint Position	Position
Wait for Tripped	N/A

RSLogix 5000 software uses the MAW instruction to arm the axis to watch for the axis to reach a certain position and the MDW instruction to disarm a watch position that is armed but has not occurred yet.

You can use the On Watch block with the Watch Control block for a position event and either handle program flow after the event occurs or halt the program flow as it waits for the event to occur. The Wait for Tripped function lets the Watch block be used to pause the existing motion task (not the other tasks) and wait for the event to occur. Either function could be used, but not both for the same event.

The MAW motion instruction in RSLogix 5000 software does not provide the capability of pausing the ladder scan and, if in a continuous task, is not a prioritized task. Use an Event task for a MAW instruction for optimum application usage.

#### IMPORTANT

GML software is a sequential-based programming language. Since RSLogix 5000 software is a scan-based language, the performance or execution of a watch or registration event is not immediate, instead it is based on the Motion Group Coarse Update Rate (CUR). A general rule of thumb is to expect execution no longer than 2x the CUR. In most instances of machine performance, this is not noticeable.

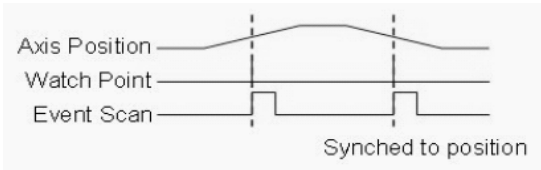
### RSLogix 5000 New Task Event for Motion Axis Watch

The screenshot shows the 'New Task' dialog box with the following settings:

- Name: Axis\_1\_Watch
- Description: (empty)
- Type: Event
- Trigger: Axis Watch
- Tag: AxisWatch\_1\_event
- Execute Task If No Event Occurs Within: 10.000 ms
- Priority: 10 (Lower Number Yields Higher Priority)
- Watchdog: 500.000 ms
- Disable Automatic Output Processing To Reduce Task Overhead: ☒
- Inhibit Task: ☐

A watch point also lets you execute specific application code when a motion axis reaches a specific location. However, a watch point is a software-based position that serves as the trigger for the event.

RSLogix 5000 Watch Point Event



Watch Control Block and Motion Axis Registration (MAR) Instruction

Watch Control

Watch Control | Registration

Type

☒ Arm

☐ Disarm

☐ Enable Event/Action

Class: Registration

Input: Registration

Axis: A020

OK Cancel Apply Help

Watch Control

Watch Control | Registration

Trap State

☒ Off to On

☐ Either Transition

☐ On to Off

☒ Use Window

Minimum Position: 0

Maximum Position: 100

☐ Auto Rearm Input

☐ Wait for Tripped

OK Cancel Apply Help

Watch Control

Watch Control

Type

☐ Arm

☒ Disarm

☐ Enable Event/Action

Class: Registration

Input: Dedicated

Axis: A0150

OK Cancel Apply Help

MAR

Motion Arm Registration

Axis: Axis0

Motion Control: Arm\_Registration

Trigger Condition: Positive\_Edge

Windowed Registration: Disabled

Min. Position: 0

Max. Position: 100

Input Number: 1

(EN) (DN) (ER) (IP) (PC)

MDR

Motion Disarm Registration

Axis: Axis0

Motion Control: Disarm\_Registration

Input Number: 1

(EN) (DN) (ER)

**Comparing Watch Control Parameters**

<b>GML Software Parameter</b>	<b>RSLogix 5000 Software Parameter MAR</b>
Axis	Axis
Off to on transition	Trigger condition - positive edge
On to off transition	Trigger condition - negative edge
Either transition	N/A
Use window	Windowed registration
Minimum position	Min. Position
Maximum position	Max. Position
Auto rearm input	N/A
Wait for completion	N/A

The Watch Control function block does not require you to designate which input you are using for registration. Each 1394 axis module has a dedicated 5V dc registration input and 24V dc registration input on the 1394 system module. However, you can only use one of them for each axis. Each Kinetix 6000 drive module has two dedicated 24V dc registration inputs for each axis.

You can use the On Watch block with the Watch Control block for a registration event and either handle program flow after the event occurs or halt the program flow as it waits for the event to occur. The Wait for Tripped function lets the Watch block be used to pause the existing motion task (not the other tasks) and wait for the event to occur. Either function could be used, but not both for the same event.

RSLogix 5000 software uses the MAR instruction to arm the axis to watch for a registration event and the MDR instruction to disarm a registration event that is armed but has not occurred yet. The MAR and MDR instructions have a parameter called Input Number to designate which of the two inputs a particular motion instruction is accessing.

The MAR motion instruction in RSLogix 5000 software does not provide the capability of pausing the ladder scan and, if in a continuous task, is not a prioritized task. Use an Event task for a MAR instruction to prioritize the event scheduling in RSLogix 5000 software.

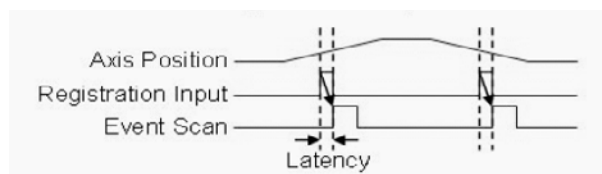
### RSLogix 5000 New Task Event for Axis Registration

The 'New Task' dialog box contains the following fields and options:

- Name:** Axis\_1\_Registration
- Description:** (Empty text box)
- Type:** Event
- Trigger:** Axis Registration 1
- Tag:** Reg\_1\_event
- ☐ Execute Task If No Event Occurs Within 10.000 ms
- Priority:** 10 (Lower Number Yields Higher Priority)
- Watchdog:** 500.000 ms
- ☒ Disable Automatic Output Processing To Reduce Task Overhead
- ☐ Inhibit Task

A registration input lets you execute specific application code when a motion axis reaches a specific location. A physical device determines the location and triggers the task.

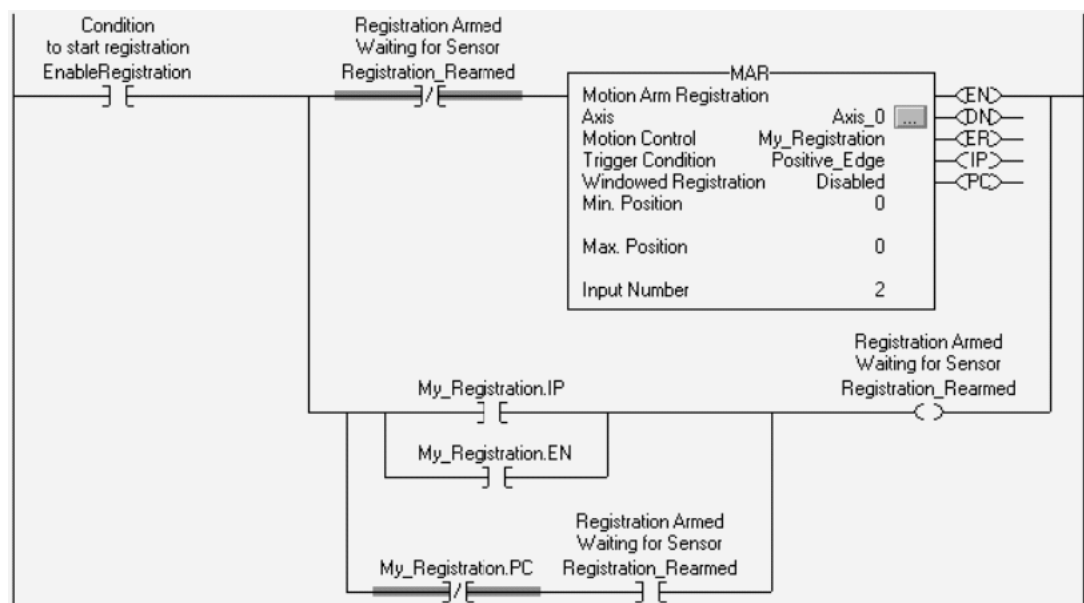
### RSLogix 5000 Registration Input Event



There are three Motion Axis Registration functions in the GML software blocks that are not specific to the MAR blocks in RSLogix 5000.

- Either transition. The MAR instruction can trigger positive edge or negative edge and not both, as in the GML Watch Block.
- Auto-rearm input. The MAR instruction does not have this specific re-arm of the function. However, it is recommended to use the following code. Note the rung must change from false to true to re-arm (dependant on the ladder scan and coarse update rate).

### RSLogix 5000 Code Example Executing Auto-rearm of MAR Instruction



- Wait for Tripped. The Wait for Tripped selection in the Watch Position block or the On Watch block can be used to pause a specific task until the event occurs.

### IMPORTANT

GML software is a sequential-based programming language. Since RSLogix 5000 software is a scan-based language, the performance or execution of a watch or registration event is not immediate, instead it is based on the Motion Group Coarse Update Rate (CUR). A general rule of thumb is to expect execution no longer than 2x the CUR. In most instances of machine performance, this is not noticeable.

For more information on event-based tasks, refer to Using Event Tasks with Logix5000 Controllers, publication [LOGIX-WP003](#).

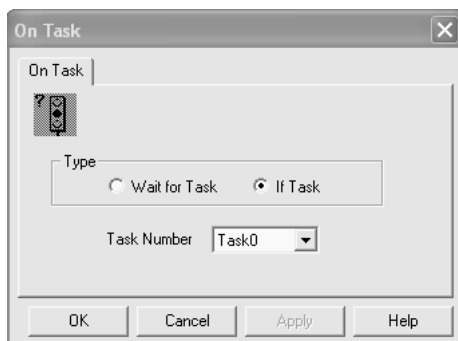
The performance of a similar Axis Watch or Registration in the Logix 5000 architecture may vary from that in the GML code simply due to processor speed, scan times, and coarse update rate.



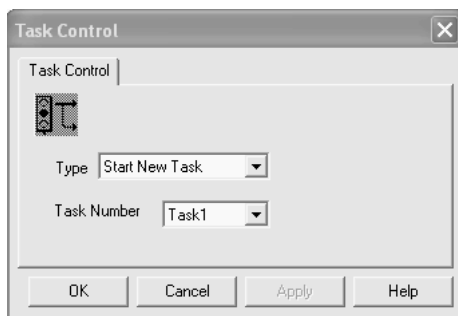
## *On Task and Task Control*

The On Task and Task Control function blocks are used in GML software for task control. You can have up to ten motion tasks executing at one time and you may, for example, have tasks waiting for an event or other block to execute.

### **GML On Task Block**



### **GML Task Control Block**

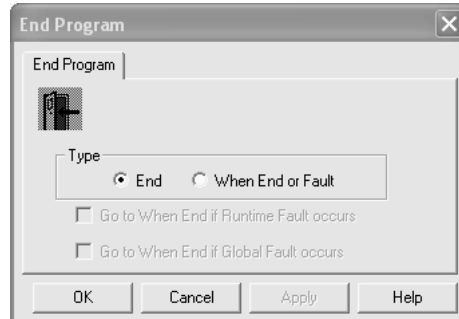


You can have 32 tasks operating in the Logix5000 Architecture. You can use periodic or event driven tasks with up to 15 prioritization schedules. There are also Program Control blocks in the RSLogix 5000 instructions, such as Jump to a Subroutine (JSR) or Return from Subroutine (RET), to help with program flow.

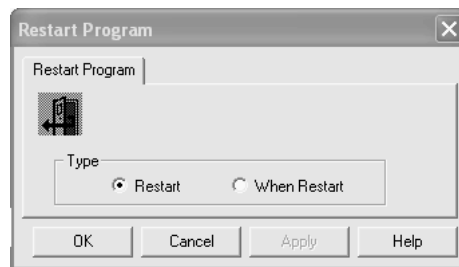
### *End Program and Restart Program*

The End Program and Restart Program function blocks are used in GML software to end or start a program at any point in the program. Restart Program also lets you begin the program after some fault routine or determination of an anomaly in the GML program.

#### **GML End Program Block**



#### **GML Restart Program Block**

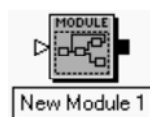


In RSLogix 5000 software, the Master Control Relay (MCR) instruction is a mandatory hard-wired relay that can be de-energized by any series-connected emergency stop switch. When used in pairs, the MCR instruction creates a program zone that can disable all rungs with MCR instructions. To restart, use state logic to determine where in the program the actual sequence stopped.

### *New Module*

The New Module function block is used to create a subroutine of motion instructions that are used for program maintenance or for external use in the Call Module function at some point in the program.

#### **GML New Module Block**

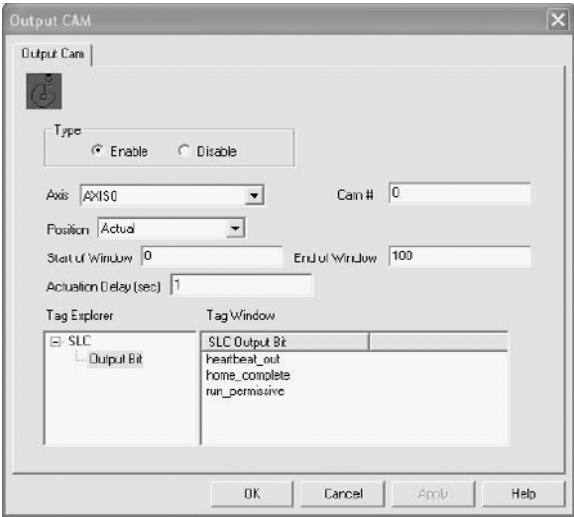


The creation of a task, program, or routine replaces this function based on the need in RSLogix 5000 software code.

Output CAM

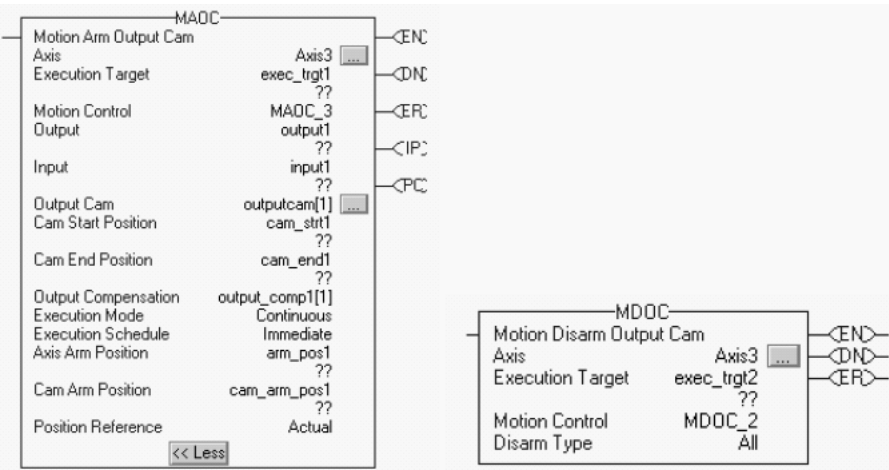
You can configure up to 48 output cam profiles for Flex I/O, RIO discrete, SLC, or general purpose outputs. These output cam profiles turn on or off at specific axis positions. This block is used to enable or disable the output cam function.

GML Output CAM Block



In RSLogix 5000 software, the Output Cam objects in the MAOC instruction handle the Motion Planner Object Cam functionality. Each Output Cam object is responsible for one output which consists of 32 output bits. Each single output bit can be programmed separately with an Output Cam profile and compensated for position offset and time delay.

RSLogix 5000 MAOC/MDOC Instructions



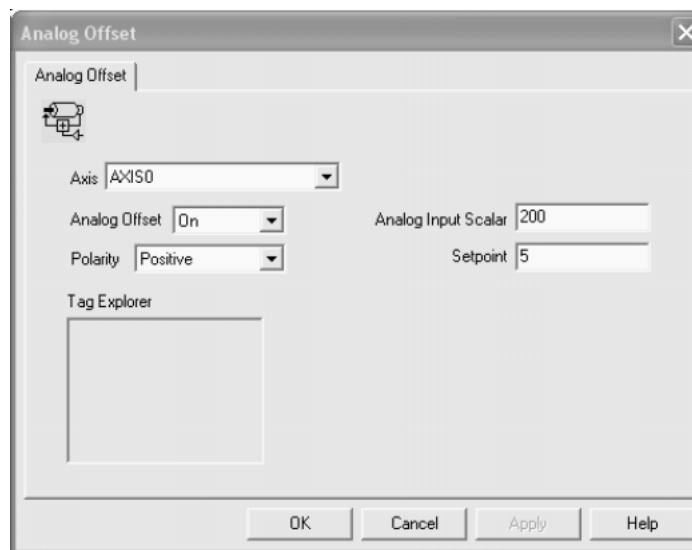
### Comparing Output CAM Parameters

GML Software Parameter	RSLogix 5000 Software Parameter MAOC
Type	MAOC (enable) or MDOC (disable)
Axis	Axis
Cam #	Execution Target
Position	Position Reference
Start of Window	Cam Start Position
End of Window	Cam End Position
Actuation Delay	Output Compensation
Tag Explorer	Execution Target

### Analog Offset

This GML function block lets the position controller use an external analog input for a scaled position offset to be added to the commanded position output. This analog input is secured through Flex I/O Analog Input modules (catalog numbers 1794-IE8 or 1794-IE4XOE2).

### GML Analog Offset Block



The Kinetix 6000 drive cannot accept a direct analog offset into the position command. You can bring an analog input into the Logix controller and assign a periodic task to monitor the input and act on that task, but it is not at a servo rate update. If this function is important, use the Kinetix 7000 drive, which has an analog input on the 26-pin IOD connector. You must configure the analog input with real-time attributes and scaling changes are possible with an MSG instruction. RSLogix 5000 (version 16 or later) software is required.

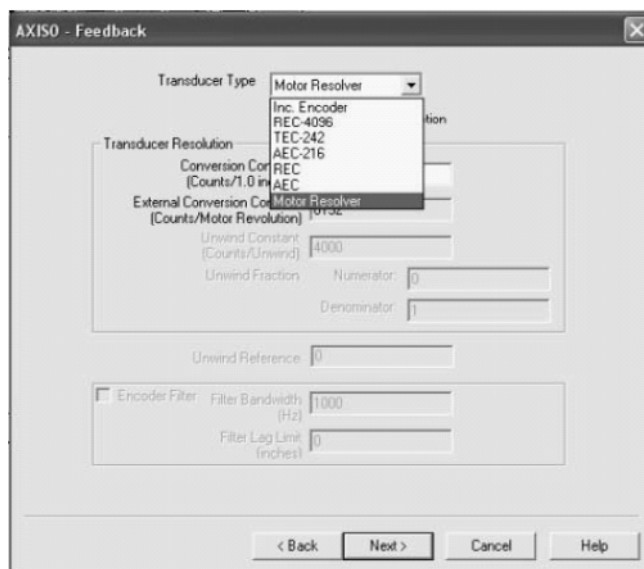
## REC, AEC, TEC, and ALEC Module Conversion

The REC, AEC and TEC converters provide various types of auxiliary feedback input to the 1394 system module. The ALEC converter provides encoder input over AxisLink communication to the 1394 GMC system module for axis coordination.

The GML software setup for REC, AEC, and TEC modules is done in the Axis Setup Options dialog. If the motor being used is the physical axis (velocity feedback), an incremental encoder, REC, AEC, or TEC is the position feedback or what is called dual-loop configuration. If Master Axis or Feedback Only is selected, the incremental encoder (REC, AEC, or TEC) is the position feedback.

Either way, the feedback from these devices is brought in on the 1394 system module (GMC or GMC Turbo) 12 pin, auxiliary axis termination.

### GML Axis Feedback Setup



### REC Converters

The REC device is a Resolver to Encoder Converter (catalog numbers REC-4096 and REC). Catalog number REC superseded REC-4096.

The REC module converts a single or dual (Master/Vernier) resolver input signal to an AQuadB quadrature encoder output signal. The AQuadB quadrature output signal can be directly connected to the 1394 GMC system module. The REC module also has two resolver input channels.

The Kinetix 6000 drive supports transmitter style resolver feedback, but only with specific performance parameters as found on Bulletin 1326AB-Bxxxx-21, 1326AS-Bxxxx-21, and MPL-BxxxxR (resolver) motors. Use of 2090-K6CK-D15MF low-profile connector kit is required to make drive connections from 1326AB/AS motors.

For a smoother migration to Kinetix 6000 drives, move to an absolute feedback device embedded in standard Rockwell Automation products such as the MP-Series low-inertia motors (catalog number MPL-B330P-M, for example) with absolute feedback capability.

---

**IMPORTANT**

Due to compatibility issues, do not terminate the REC converted encoder signal at the auxiliary feedback (AF) connector on the Kinetix 6000 drive module.

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Refer to the REC Resolver-to-Encoder Converter Installation and Setup Manual, publication [999-126](#), for more information.

### *AEC Converters*

The AEC device is an Absolute Encoder to Encoder Converter (catalog numbers AEC-216 and AEC). Catalog number AEC superseded AEC-216.

The AEC module receives the absolute position data sent by the SSI transducer and changes it to an incremental quadrature signal for the 1394 GMC system module. The Kinetix 6000 drive modules do not support SSI type feedback. SSI devices are clock driven devices and are not compatible with the Kinetix 6000 drive feedback input. You can, however, utilize an SSI type input to the ControlLogix analog module (catalog number 1756-M02AS).

For a smoother migration to Kinetix 6000 drives, move to an absolute feedback device embedded in standard Rockwell Automation products such as MP-Series low-inertia motors (catalog number MPL-B330P-M, for example) with absolute feedback capability.

---

**IMPORTANT**

Due to compatibility issues, do not terminate the AEC converted encoder signal at the auxiliary feedback (AF) connector on the Kinetix 6000 drive module.

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Refer to the AEC Absolute Encoder Converter Installation and Setup Manual, publication [4100-5.2](#), for more information.

### *TEC Converters*

The TEC device is a Transducer (Temposonics linear scale) to Encoder Converter (catalog number TEC-242).

The TEC-242 module lets you use Temposonics non-contacting magneto-strictive feedback transducers with the 1394 GMC system module. This module provides two complete channels of Temposonics-to-encoder format signal conversion and two complete channels of voltage-to-current conversion for directly driving hydraulic servo valves from  $\pm 10V$  output motion controllers.

The Kinetix 6000 drive modules do not support Temposonic feedback. If the existing system uses a 1394 analog system module and hydraulic valve control, your conversion should include the ControlLogix analog servo module (catalog number 1756-HYD02) for hydraulic valve control and Temposonics feedback. You can terminate a feedback-only axis or Temposonic feedback on the analog module.

---

**IMPORTANT**

Due to compatibility issues, do not terminate the TEC converted encoder signal at the auxiliary feedback (AF) connector on the Kinetix 6000 drive module.

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Refer to the TEC-242 Transducer to Encoder Converter Installation and Setup Manual, publication [999-059](#), for more information.

### *ALEC Module*

The ALEC module is a single-axis AxisLink Encoder Converter which interfaces a single incremental encoder to the 1394 GMC system module via AxisLink communication. It provides a master encoder input for 1394 GMC systems without the need to sacrifice a full servo axis for use as a master encoder input.

The ALEC module is not compatible with Kinetix 6000 drives or the Logix platforms. However, Kinetix 6000 drives are governed by SERCOS interface communication and you can utilize up to 32 axes per Logix controller.

For example, if a 5V differential line-drive type encoder is connected to an ALEC module and terminated on the 1394 GMC system module, you can rewire from the encoder directly to the Kinetix 6000 drive auxiliary feedback (AF) connector and configure the axis as Feedback Only. Make sure the master encoder feedback specifications are listed as compatible in the Kinetix 6000 User Manual, publication [2094-UM001](#).

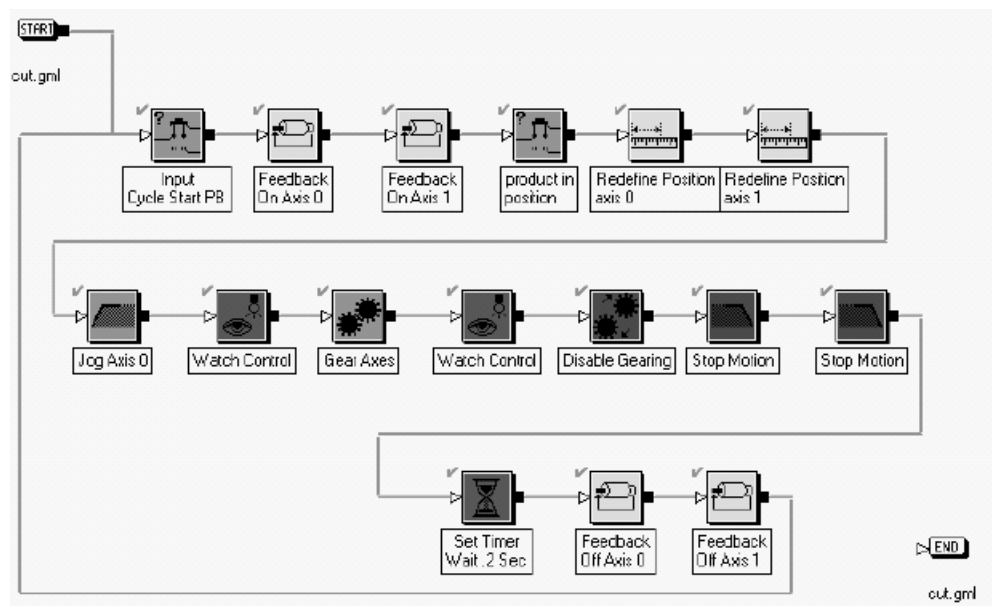
Refer to the ALEC AxisLink Encoder Converter Installation and Setup Manual, publication [4100-5.3](#), for more information.

## GML to RSLogix 5000 Software Conversion Example

Because of the sequential nature of the GML block diagram, the conversion of the program can be done using state logic to program the ladder logic in the RSLogix 5000 software. State logic lets the programmer sequentially move through a sequence of ladder logic rungs by incrementing a value in a variable and then using the value of that variable to determine which step in the sequence to initiate.

In this example, the GML diagram for a simple cut to length application is converted to ladder logic using state logic. The value stored in the variable `Cut_To_Length_Sequence_Step` is used to determine which step in the ladder logic to execute.

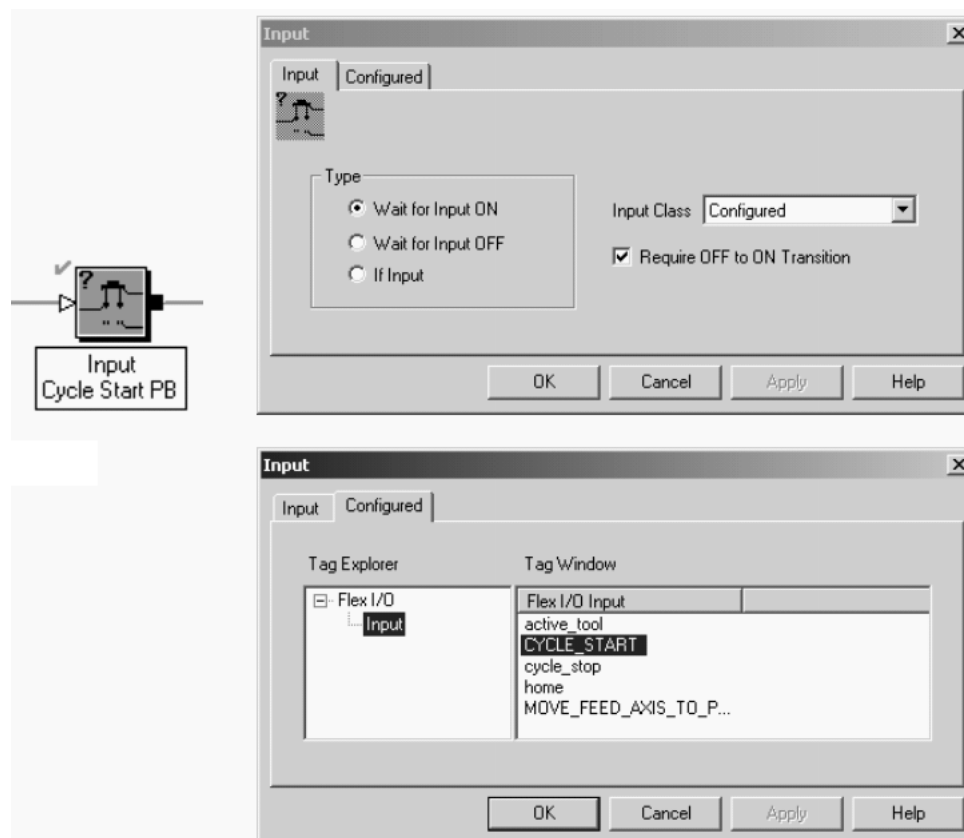
### Typical GML Diagram for Cut to Length Application





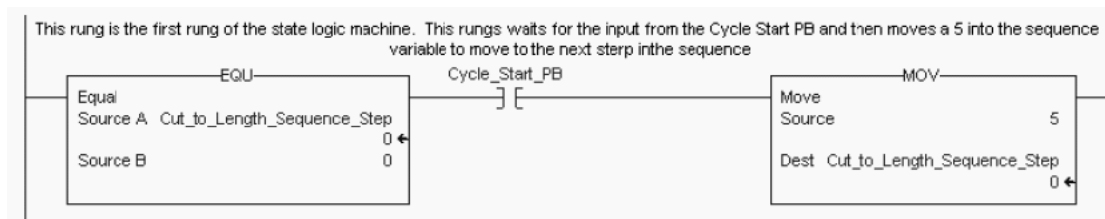
The first block in the GML diagram is an Input block configured to wait for a Flex I/O input to turn on indicating that the input has been pressed.

### GML Input Block



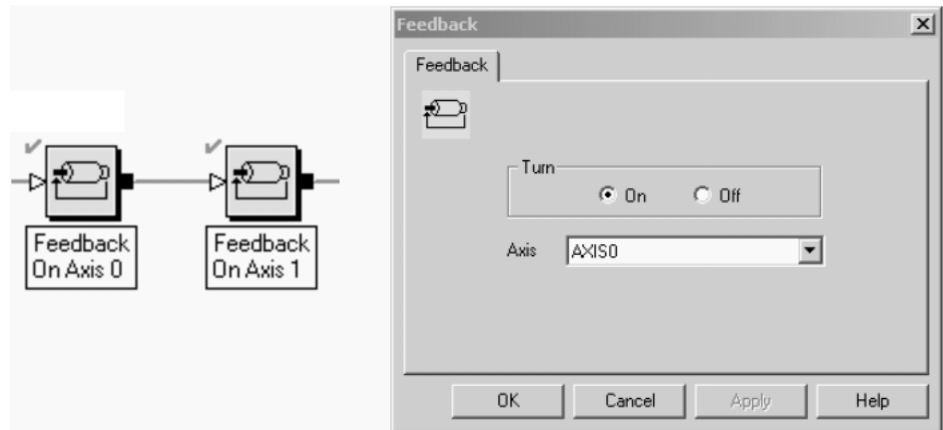
In ladder logic the first step of the sequence starts with the Cut\_to\_Length\_Sequence\_Step equal to zero. When the Cycle\_Start\_PB is pressed a value of 5 is placed into the sequence step variable to move to the next step.

### RSLogix 5000 Code Example Use of State Logic and Cycle Start Input



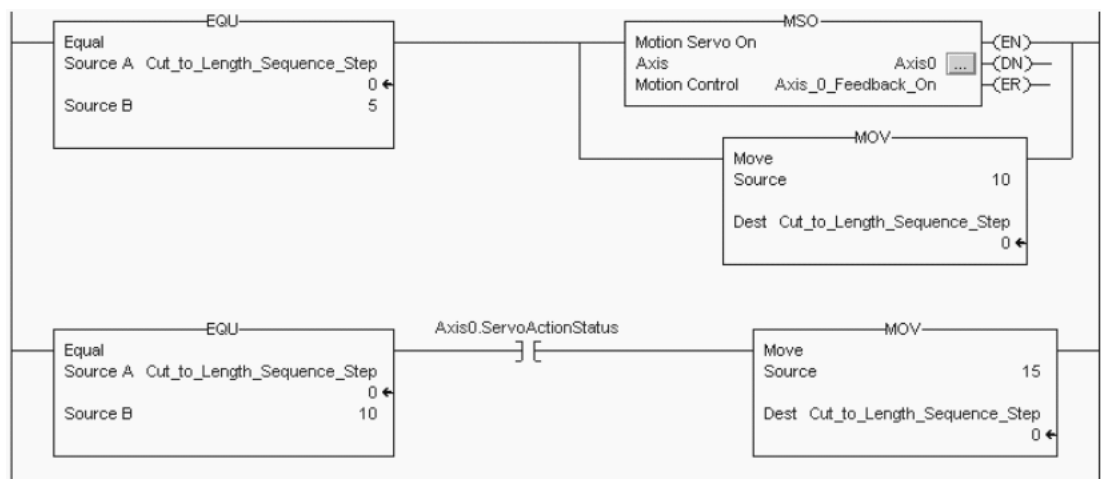
The next two blocks in the diagram are Feedback blocks. In this example the blocks are used to turn feedback on or enable both Axis0 and Axis1.

### GML Feedback Block



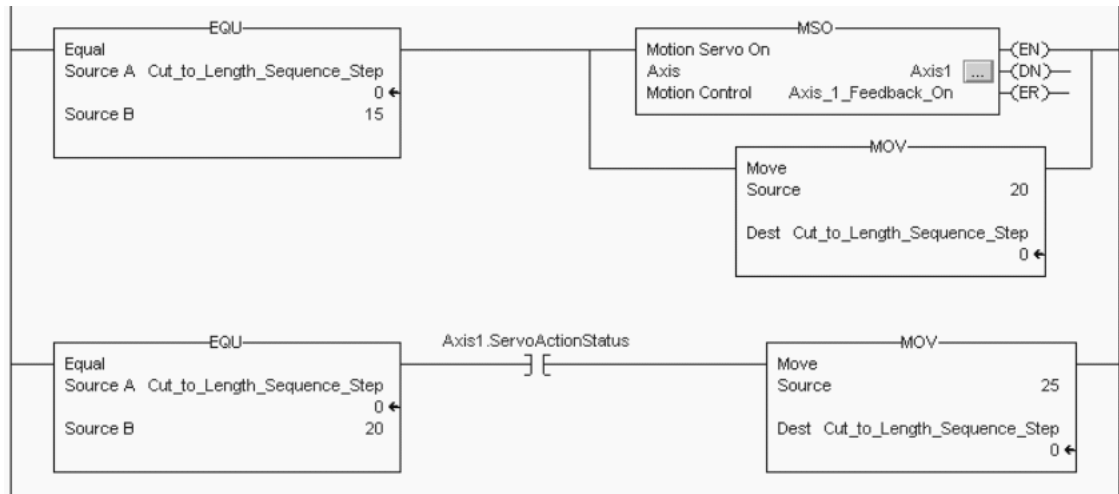
In ladder logic, when the sequence step variable equals 5, an MSO instruction is used to enable Axis0. A value of 10 is also moved into the sequence step variable to move on to the next step, which checks to make sure that the axis does enable by examining the Axis0.ServoActionStatus bit. When this bit equals 1, the axis is enabled and ready for motion commands. When the bit equals 0 the axis is disabled. Once the axis is enabled, a 15 is placed into the sequence variable to move on to the next step.

### RSLogix 5000 Code Example Enable Axis\_0 and Check Servo Action Status Bit



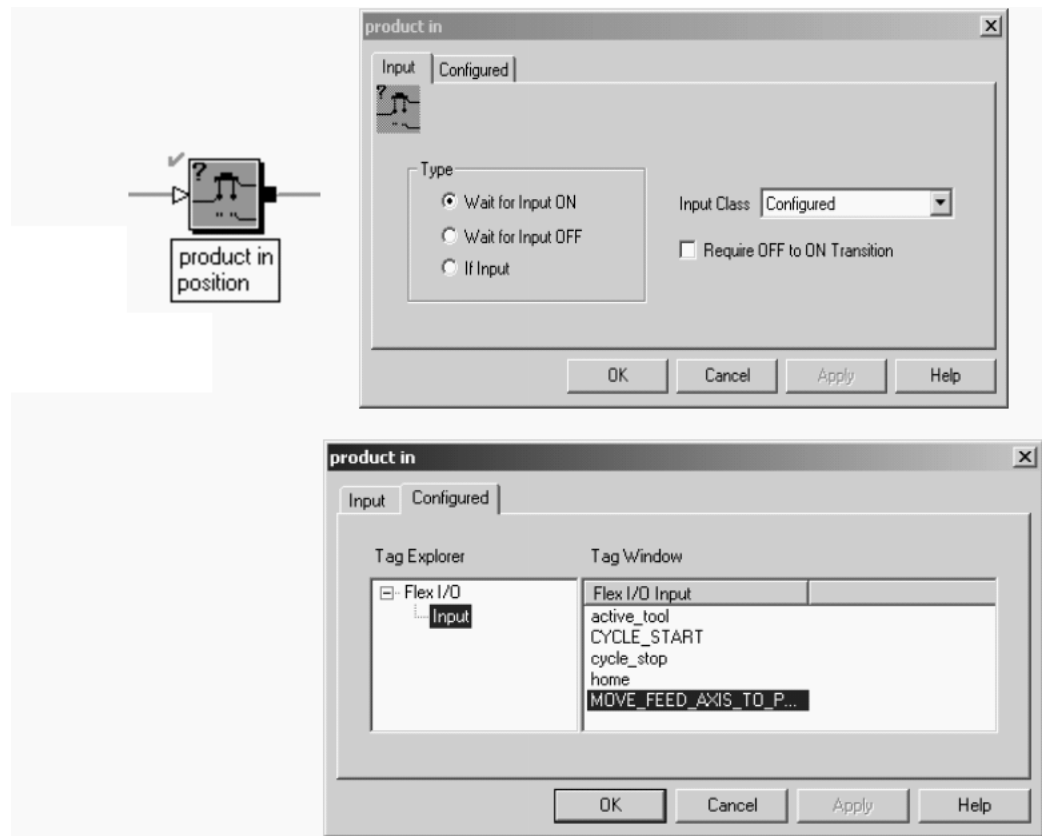
The next step in the sequence is to enable Axis1. The same procedure is followed for Axis 1 as Axis0. When the sequence variable equals 15 an MSO instruction is executed on Axis 1, the sequence variable is incremented to a value of 20, and the Axis1.ServoActionStatus bit is examined to make sure the axis is enabled. Once enabled, a 25 is placed into the sequence variable to move to the next step.

#### RSLogix 5000 Code Example Enable Axis\_1 and Check Servo Action Status Bit



The next GML function block in the sequence waits for another Flex I/O input (Move Feed Axis to Position), to turn on indicating that the material is in the correct position to begin the cutting process.

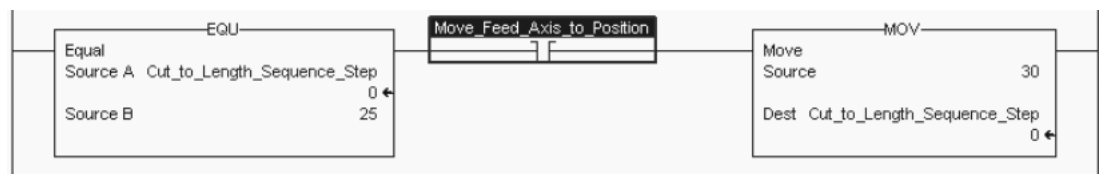
### GML Input Block Used to Find Out if Product is In Position



The ladder logic duplicates this step when the sequence step counter is equal to 25 by examining the input Move\_Feed\_Axis\_To\_Position and placing a 30 into the sequence variable when the input turns on.

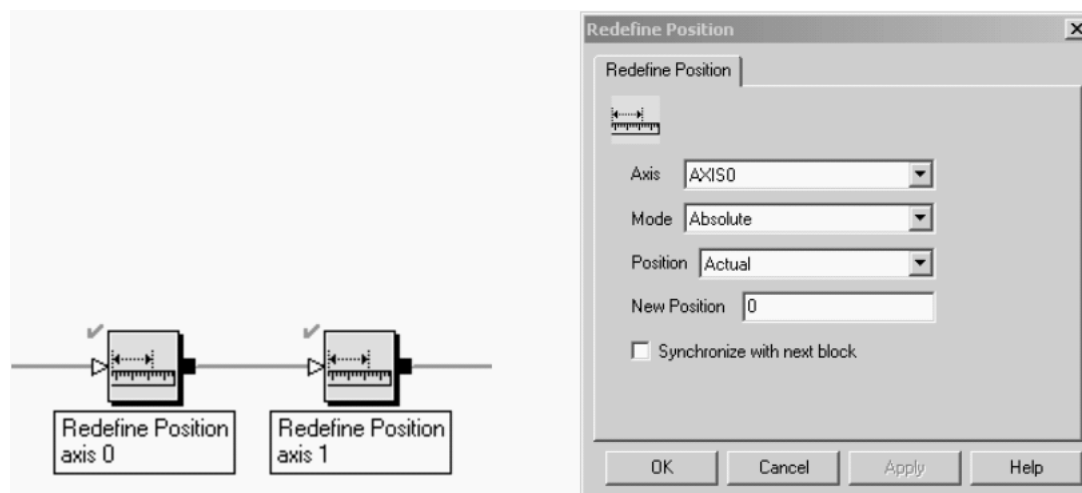
The address of this input is determined by the physical connection of the input to the ControlLogix system.

### RSLogix 5000 Code Example Checks Position Input



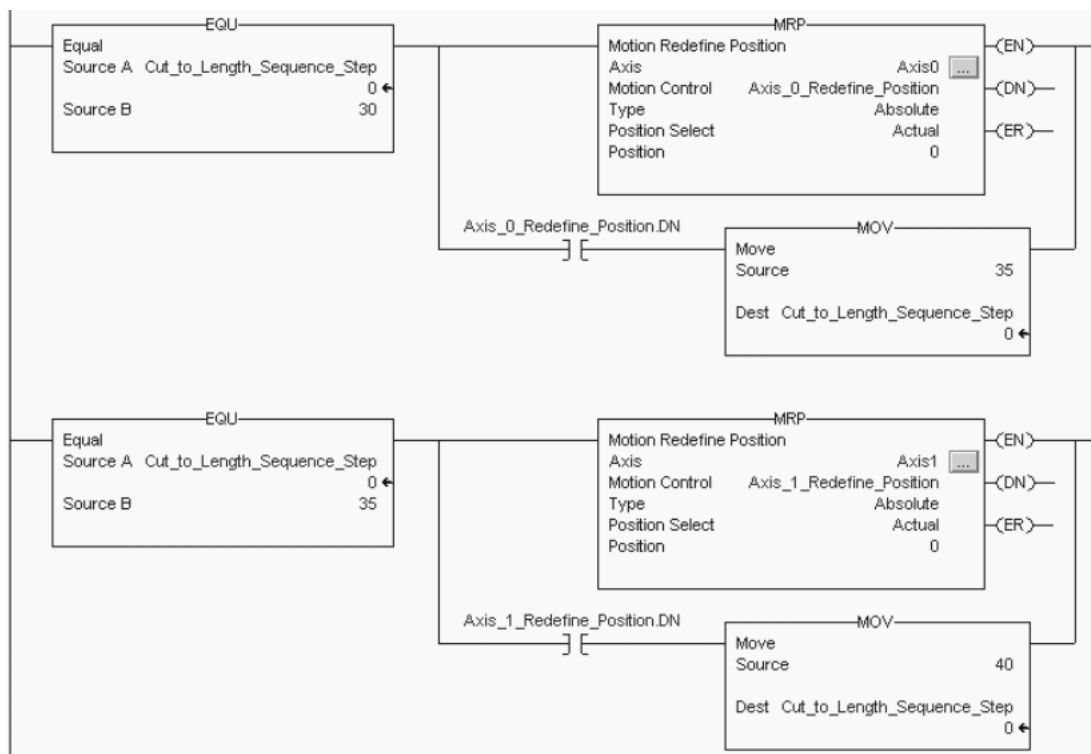
The next two function blocks in the GML diagram redefine the actual position of Axis0 and Axis1 to be equal to zero.

### GML Redefine Position Block



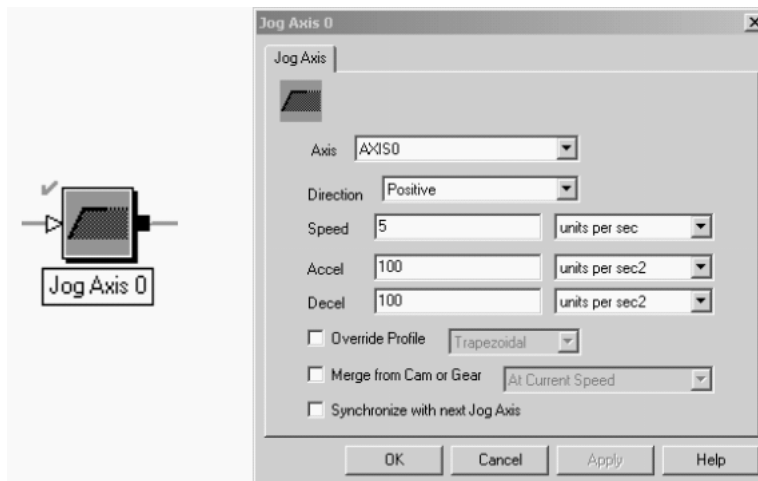
The ladder logic redefines the position of Axis0 and Axis1 to be zero in the next two rungs using an MRP instruction. In this example, the DN bit of the motion instruction is used to increment the sequence variable once the MRP instructions have completed.

### RSLogix 5000 Code Example MRP Instruction for Axis\_0 and Axis\_1



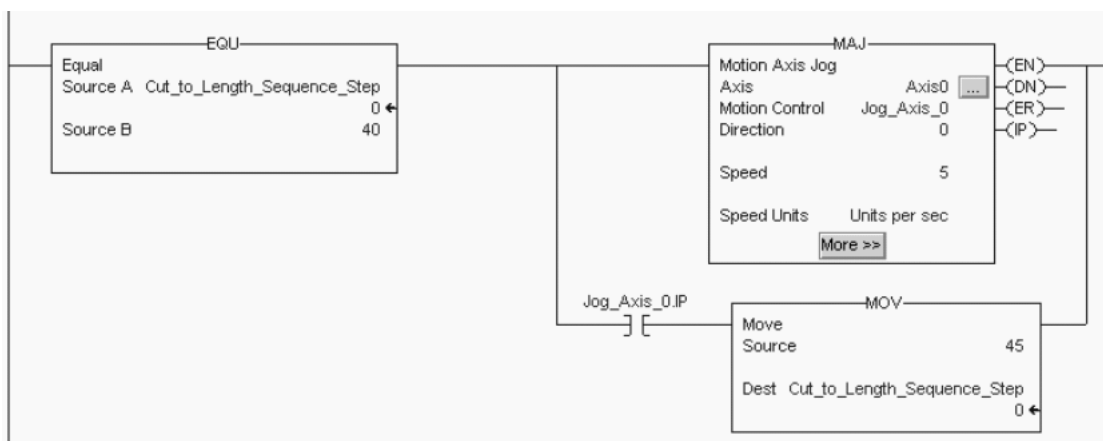
In the GML block diagram, once the two axes are redefined to be at zero, a jog is started on Axis0 to begin feeding material into the cutter.

### GML Jog Axis Block



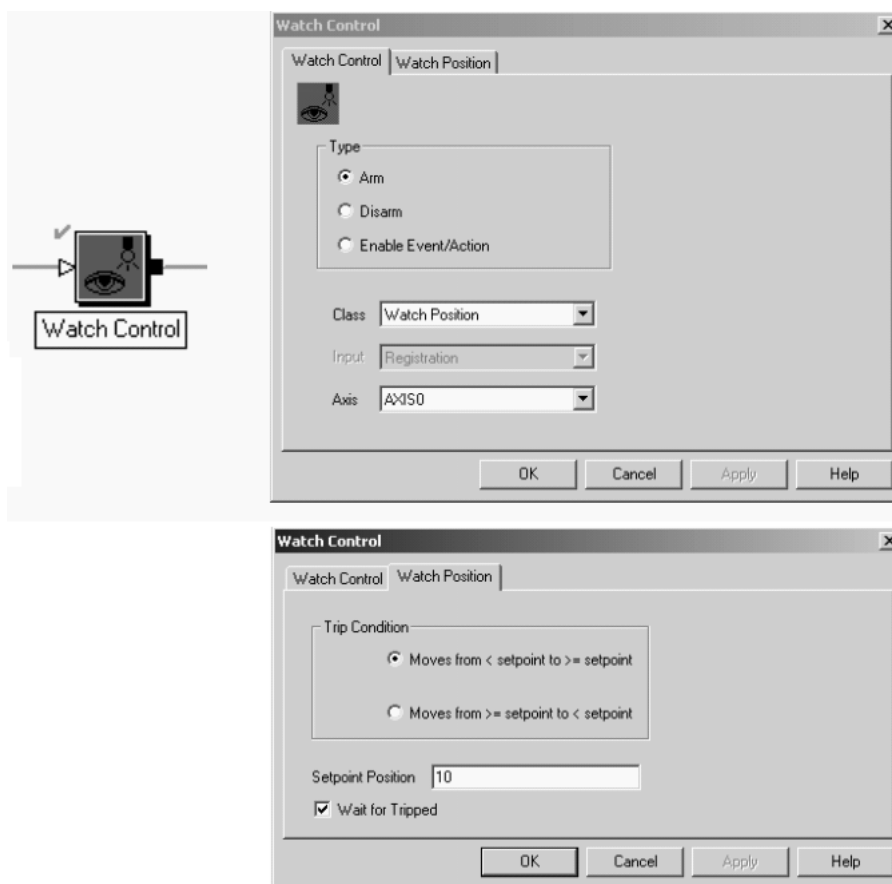
In ladder logic, once the sequence variable is equal to 40, an MAJ instruction starts a jog on Axis0. The IP or In Process bit of the motion instruction is used to verify that the jog has started before a 45 is placed into the sequence variable to move on to the next step in the sequence.

### RSLogix 5000 Code Example MAJ Instruction for Axis\_0



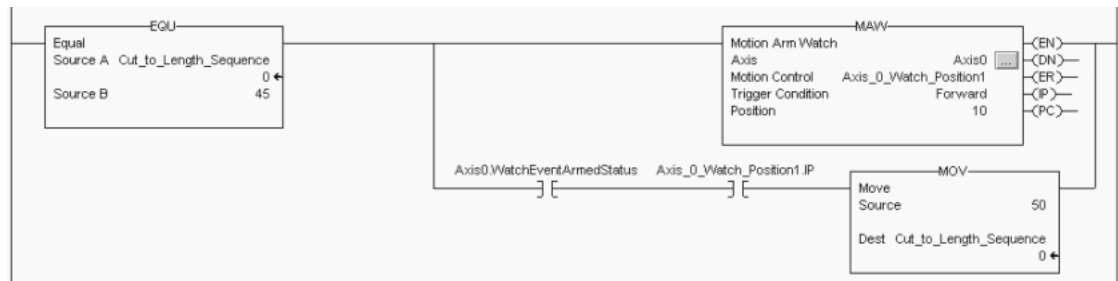
Once the jog has started, the net function block in the GML diagram arms a watch position on Axis0. The watch block looks for Axis0 to reach a position of 10 going in the positive direction. With the Wait-for-Tripped box checked on the Watch Position configuration tab of the function block, the diagram pauses until the block completes.

### GML Watch Control Block



RSLogix 5000 software performs this step using the MAW motion instruction. The instruction is configured to watch for Axis0 to reach a position of 10, moving in the forward direction, just as the Watch Position GML function block did. Since the MAW motion instruction does not have the ability to hold the program scan until Axis0 reaches the correct position, two rungs are needed to duplicate the operation of the function block. The first rung arms the watch position and uses both the IP from the motion instruction as well as the Axis0.WatchEventArmedStatus status bit, from the axis tag structure, to make sure that the watch is active before incrementing to the next rung.

### RSLogix 5000 Code Example MAW Instruction for Axis\_0



Once the watch is active, the pause on the GML diagram is duplicated by monitoring the PC bit from the motion instruction and the Axis0.WatchEventStatus status bit from the axis tag structure. When these bits turn on, Axis0 has reached the desired position moving in the correct direction as configured in the motion instruction. The next step in the sequence is initiated by moving a 55 into the sequence step variable.

### RSLogix 5000 Code Example Monitors Event to Complete

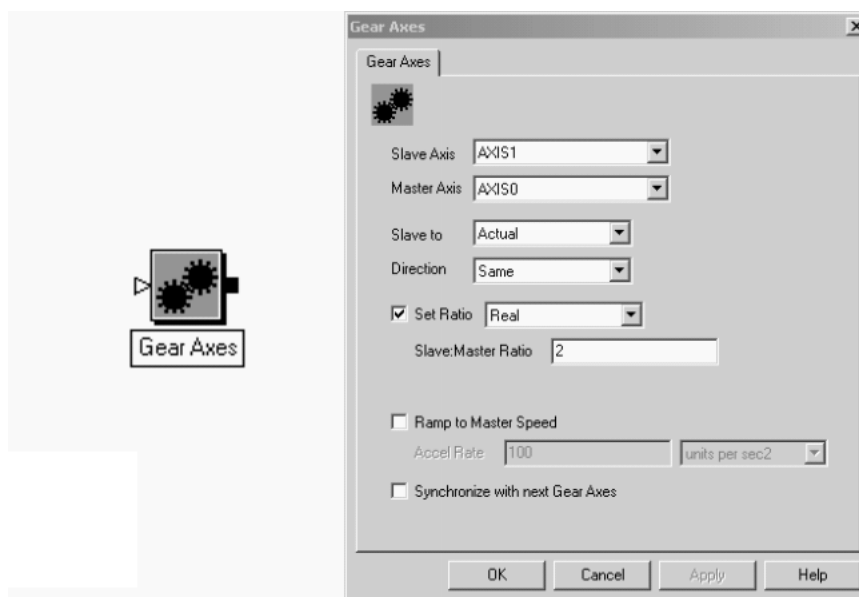




Upon completing the watch position GML function block the next step in the sequence is to gear Axis1 to Axis0. In this example function block, Axis0 is the master axis and Axis1 is the slave axis. Axis1 follows the actual position of Axis0 and runs in the same direction as Axis0. With the Set Ratio parameter set to Real, the gear ratio is configured for two position units of motion on the slave axis for every one position unit move on the master.

**TIP**

Depending on the application, it may be beneficial to use the Ramp to Master Speed function to let the slave axis smoothly move to the master axis speed.

**GML Gear Axes Block**


In RSLogix 5000 software the ladder logic to enable gearing uses the MAG instruction. The instruction is configured the same as before, with Axis0 as the master and Axis1 as the slave.

The direction of the slave axis is determined by the value of the Direction parameter. A value of 1 indicates that the slave axis runs in the opposite direction as the master. A value of 0 indicates that the slave runs in the same direction as the master.

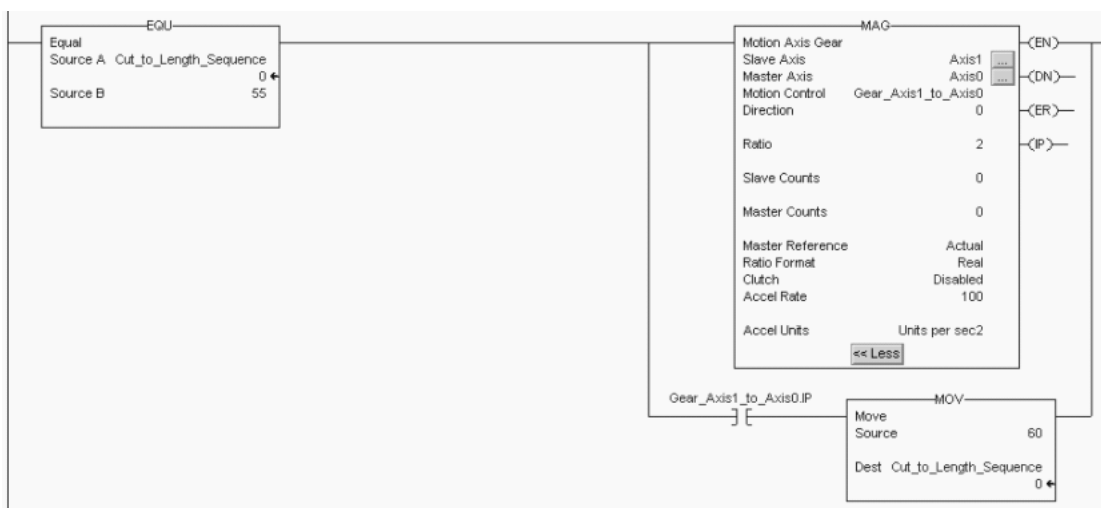
The gear ratio units are determined by the Ratio Format parameter. If Ratio Format is set to Real, then the gear ratio is in position units of the master and slave axes. The desired number of position units of motion on the slave for every one position unit of motion on the master is entered in the Ratio parameter. Values entered into the Slave Counts and Master Counts parameters are ignored. If the Ratio parameter is set to Fractional Slave Master Counts, then the gear ratio units are in feedback counts of the slave and master axis.

In this case the actual number of feedback counts of slave motion for a defined number of master encoder counts is entered in on the Slave Counts and Master Counts parameters and any value in the Ratio parameter is ignored. Once gearing is enabled, a 60 is placed into the sequence step variable to index to the next step.

**TIP**

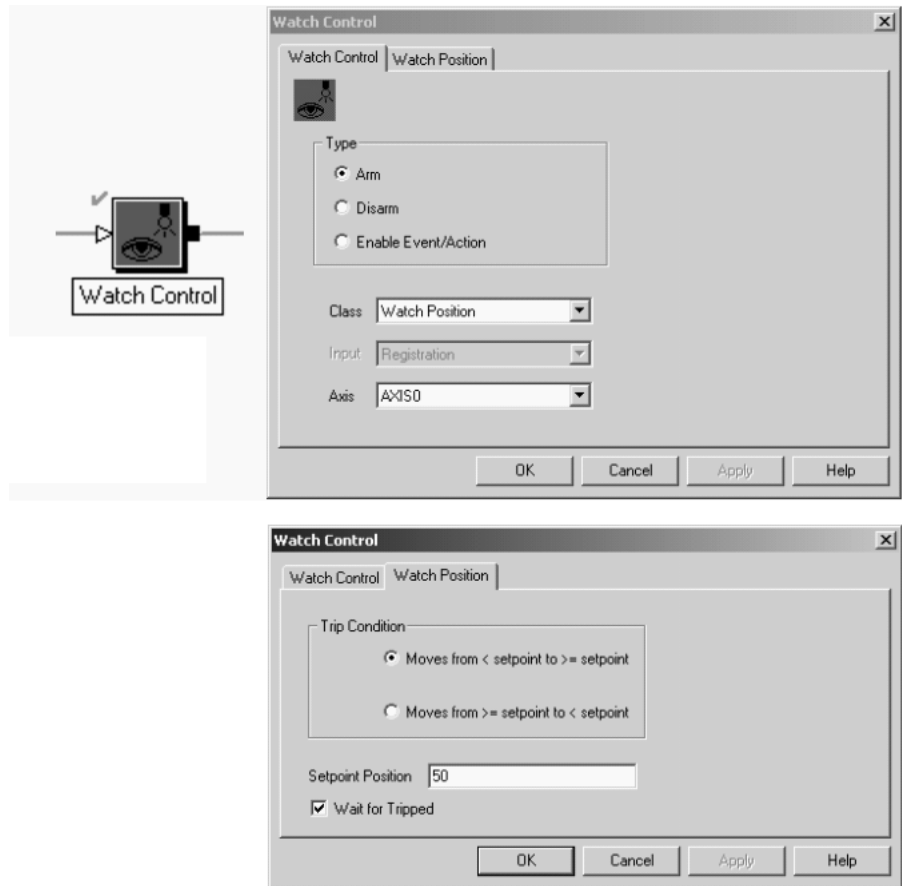
For smoother slave axis ramp to master axis speed, use the clutch function in the MAG instruction.

### RSLogix 5000 Code Example MAG Instruction Used to Gear Axis\_1 to Axis\_0



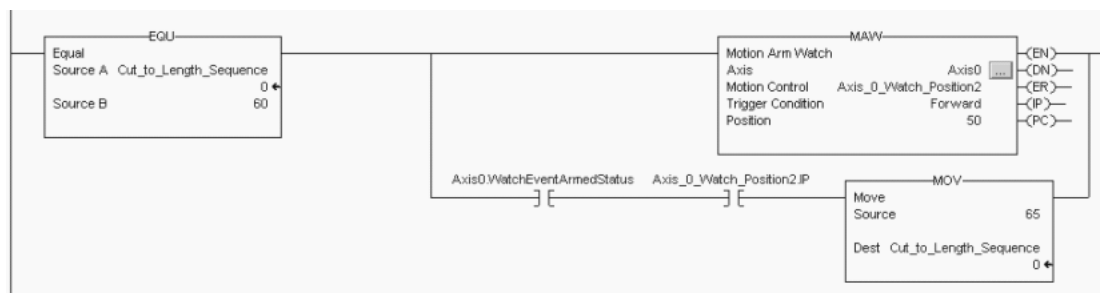
Once the gear is active, the next function block in the GML diagram arms a watch position on Axis0. The watch block waits for Axis0 to reach a position of 50, going in the positive direction. With the Wait-for-Tripped box checked on the Watch Position configuration tab of the function block, the diagram pauses at this block until the block completes.

## GML Watch Control Block



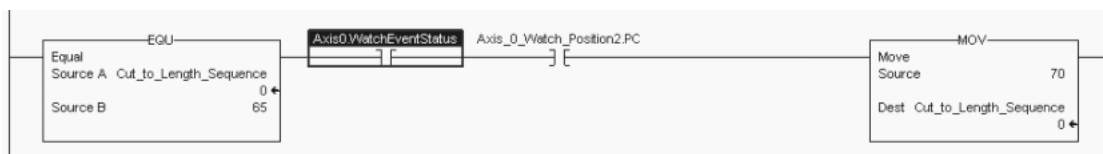
RSLogix software performs this step using the MAW motion instruction. The instruction is configured to watch for Axis0 to reach a position of 50, moving in the forward direction, just as the Watch Position function block did. Since the MAW motion instruction does not have the ability to hold the program scan until Axis0 reaches the correct position, two rungs are needed to duplicate the operation of the function block. The first rung arms the watch position and uses both the IP from the motion instruction as well as the Axis0.WatchEventArmedStatus status bit from the axis tag structure to make sure that the watch is active before incrementing to the next rung.

### RSLogix 5000 Code Example MAW Instructions to Watch Axis\_0 Position



Once the watch is active, the pause on the GML diagram is duplicated by monitoring the PC bit from the motion instruction and the `Axis0.WatchEventStatus` status bit from the axis tag structure. When these bits turn on, Axis0 has reached the desired position moving in the correct direction as configured in the motion instruction. The next step in the sequence is initiated by moving a 55 into the sequence step variable.

### RSLogix 5000 Code Example Checks Position Input



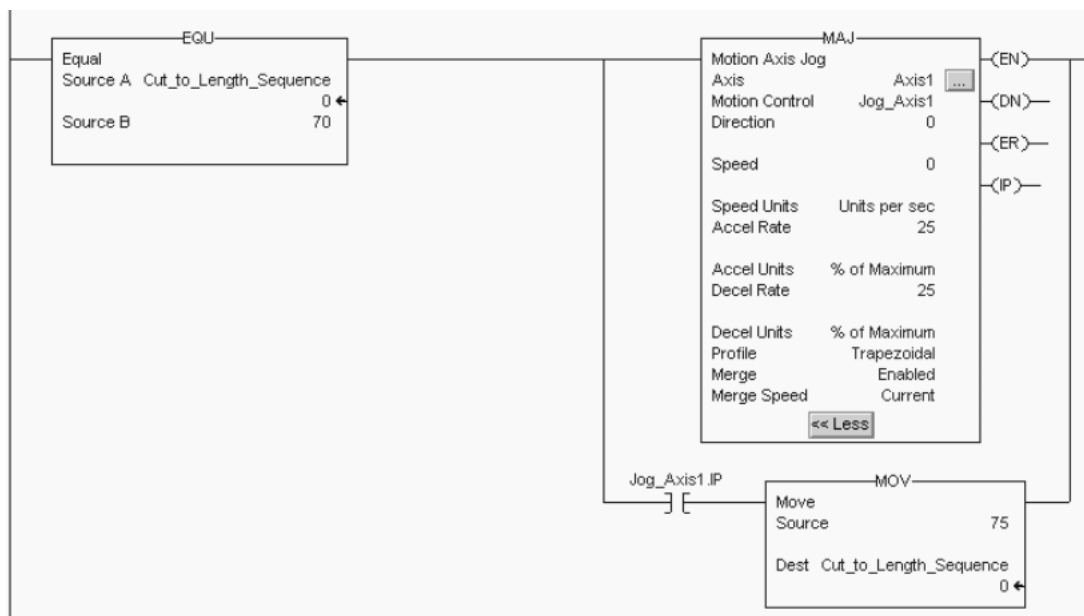
Upon completing the watch position GML function block, the next step in the sequence is to disable the gear relationship between Axis1 to Axis 0. This is done using the Disable Gearing function block. This block is configured to disable the gearing but not stop Axis1, the slave axis. By checking Continue Jog at last Master Speed, the gearing between the two axes stops, but Axis1 continues to jog at whatever the current geared speed of Axis1 is at the time the block is executed. The motion on Axis0 is unaffected by this instruction.

### GML Disable Gearing Block



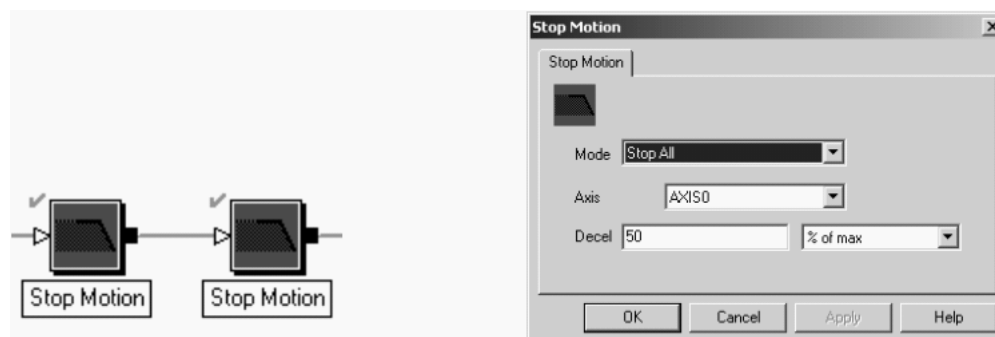
In RSLogix 5000 software this step is accomplished using the MAJ instruction with merging enabled. Merging lets the instruction cancel any other active motion on the selected axis and blend or merge into a jog. The programmer has the option of selecting a new speed or continuing at the current speed by selecting either Current or Programmed in the Merge Speed parameter. If Current is selected, then any value entered into the Speed parameter is ignored.

### RSLogix 5000 Code Example MAJ Instruction Used to Merge Axis\_1 to Current Speed



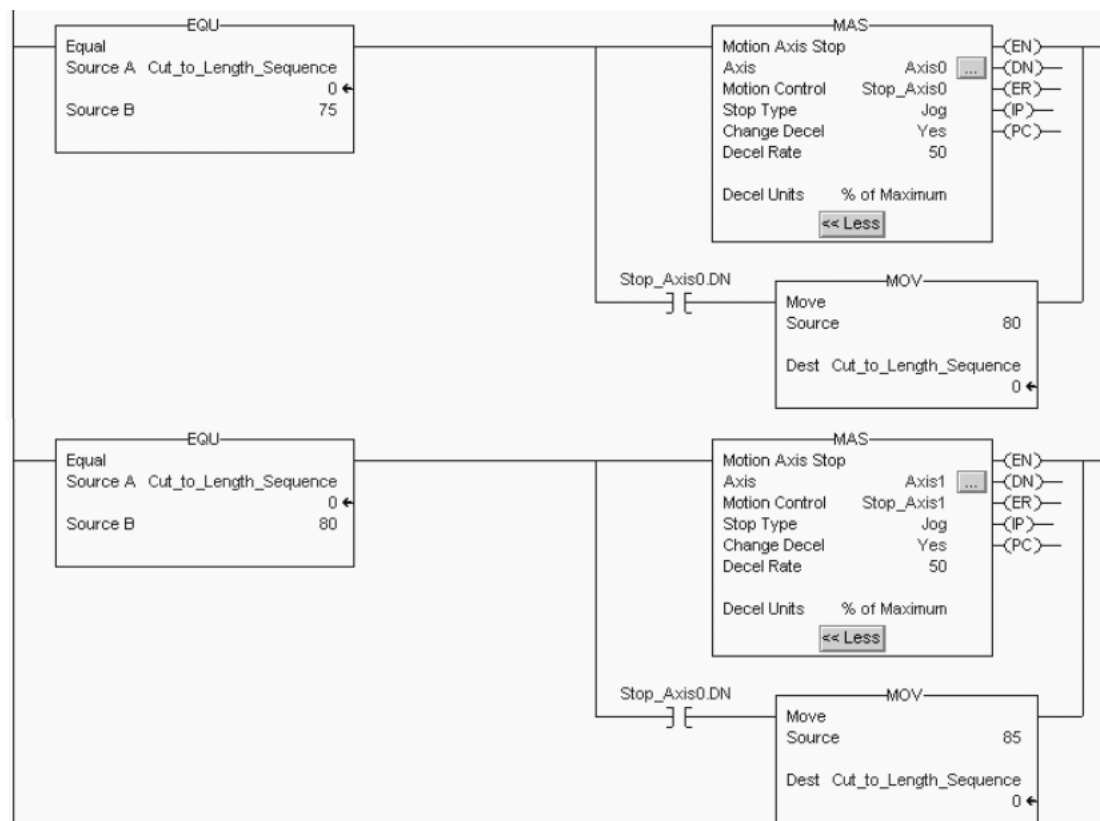
The next two blocks in the GML diagram bring both axes to a controlled stop using a user configurable deceleration rate. By checking the Continue Jog at last Master Speed box on the Disable Gear function block, the Disable Gear function block does not stop Axis0. If the box is checked, the Disable Gear function block stops Axis0 at the maximum deceleration rate of the axis.

### GML Stop Motion Block



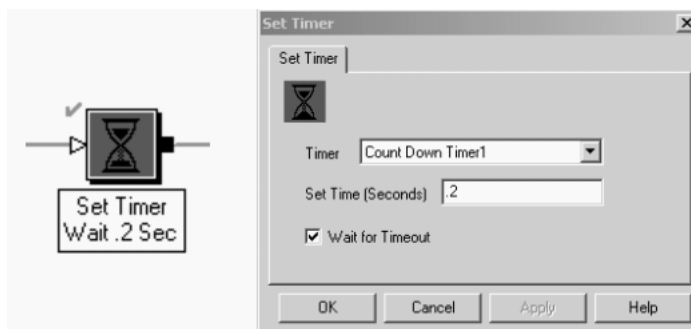
RSLogix 5000 software stops both axes using two MAS instructions with the Stop Type parameter set to Jog. With the Change Decel parameter set to Yes, the Decel Rate Parameter and the Decel Units determine the deceleration rate of the axis.

### RSLogix 5000 Code Example MAS Instruction Used to Stop Jog Function



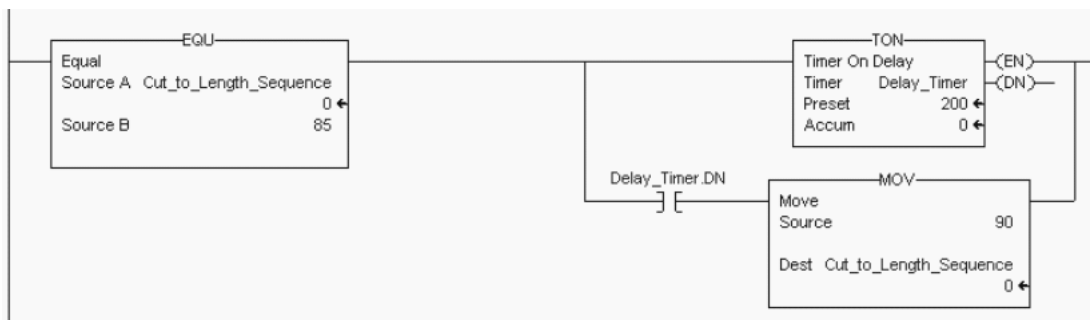
The next block in the GML diagram provides a slight delay before the next step is executed. The Wait for Timeout box is checked causing the GML diagram to pause in this block until the timer completes.

### GML Set Timer Block



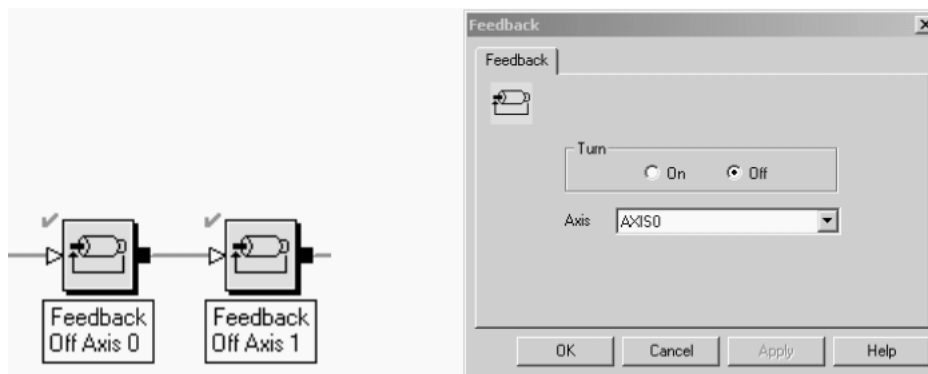
RSLogix 5000 software uses a TON instruction to duplicate this step and monitors the DN bit of the timer to determine when the timer has timed out before moving on to the next step in the sequence. All timer preset values are entered into the instruction using a time base of milliseconds (ms).

### RSLogix 5000 Code Example of TON Instruction



Finally, after the two axes have stopped and the timer times-out, the axes are disabled using two Feedback function blocks configured to turn the feedback off. The GML diagram also restarts at the beginning of the diagram by looping from the output connection of the Feedback Off Axis1 block back to the input connection of the Cycle Start PB block, and the entire sequence repeats on the next off-to-on transition of the Cycle Start PB block.

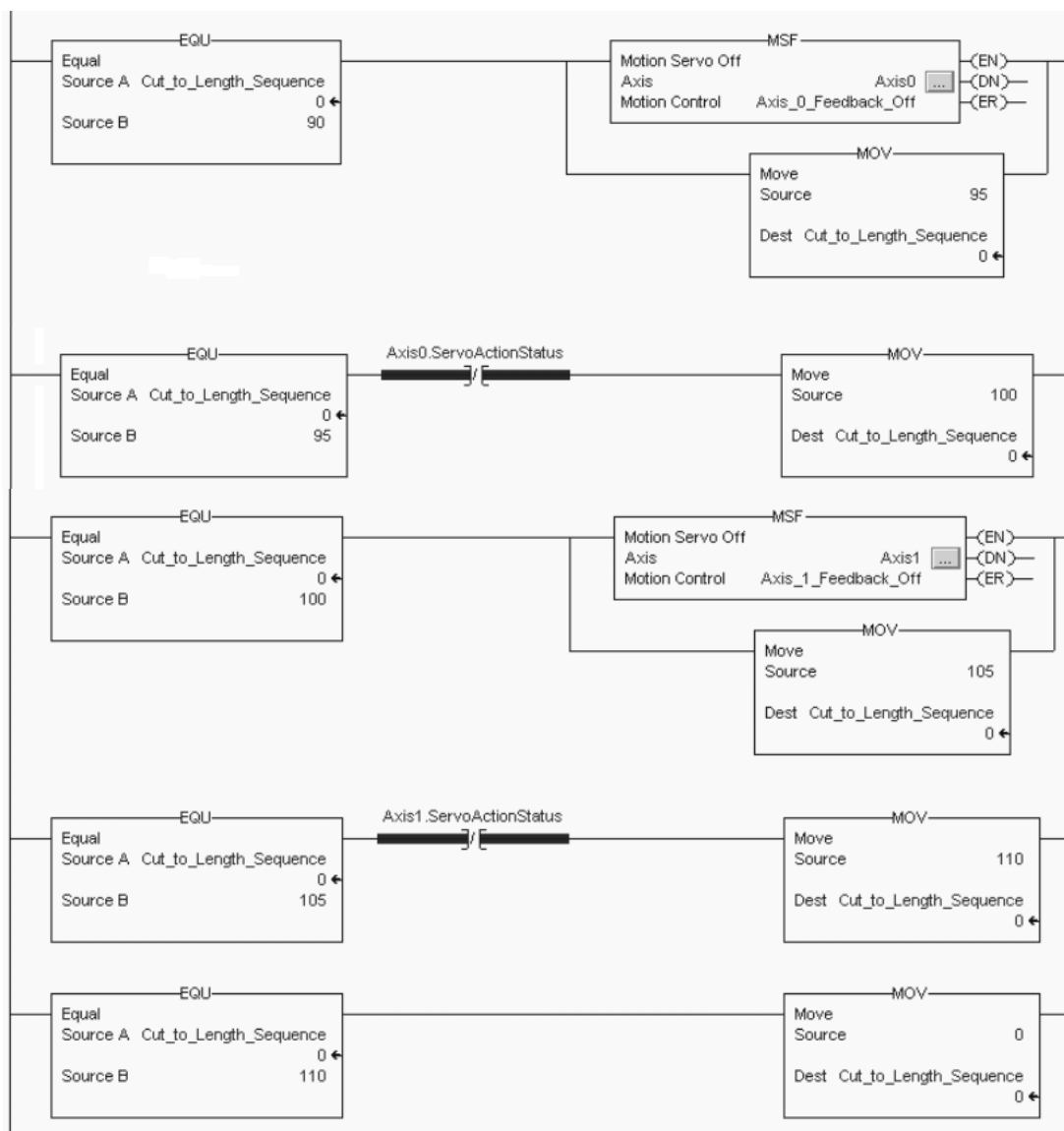
### GML Feedback Block





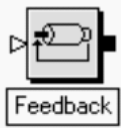
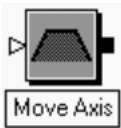


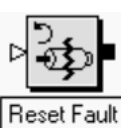



RSLogix 5000 software duplicates these steps by using two MSF instructions. After each instruction, the Axis0.ServoActionStatus and Axis1.ServoActionStatus bits are examined to make sure that the feedback for the axis is disabled before moving on to the next step. For the sequence to loop back and restart on the next off-to-on transition of the Cycle Start PB, the last rung has a 0 placed in the Cut\_to\_Length\_Sequence step, which returns the state logic to the first step in the sequence.

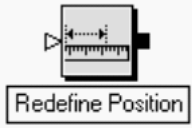
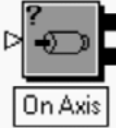



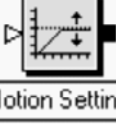

### RSLogix 5000 Code Example MSF Instruction Used to Disable Axis\_0 and Axis\_1 Servo Loops

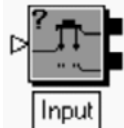
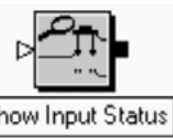
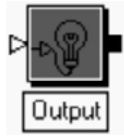

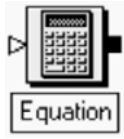


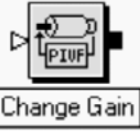
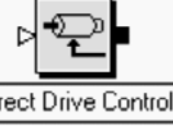



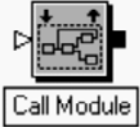






## GML and RSLogix 5000 Software Programming Reference





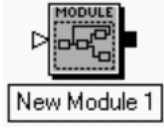



Use this table as a reference to see how the GML function blocks and RSLogix 5000 motion instructions compare.

GML Function Block	Page	Description	RSLogix 5000 Motion Instruction	Description
	80	This function block directly and immediately affects the appropriate drive enable output and feedback loop processing.	MSO	The Motion Servo On (MSO) instruction is used to enable the axis.
			MSF	The Motion Servo Off (MSF) instruction is used to disable the axis.
	82	This function block moves the servo axis to a specified absolute position or incremental distance.	MAM	The Motion Axis Move (MAM) instruction initiates a move for a specified axis.
	84	This function block continuously moves a servo axis in a specified direction at a specified speed.	MAJ	The Motion Axis Jog (MAJ) instruction initiates a jog for a specified axis.
	87	This function block enables electronic gearing between two axes at a specified ratio.	MAG	The Motion Axis Gear (MAG) instruction provides electronic gearing between two specified axes in a specified direction at a specified ratio.
	89	This function block clears all axis faults or a specified fault on a specified axis. It can also reset the 1394 drive.	MAFR or MASR	The Motion Axis Fault Reset (MAFR) instruction clears all motion faults for a specified axis. The Motion Axis Shutdown Reset (MASR) instruction can clear, when corrected, an axis shutdown condition.
	90	This function block stops all motion or a specified type of motion on the selected axis. It can also be used to Kill Control.	MAS	The Motion Axis Stop (MAS) instruction initiates a controlled stop of any motion process on a specified axis.
	91	This function block performs the homing operation and redefines the actual position of the selected axis.	MAH	The Motion Axis Home (MAH) instruction is used to home the specified axis.
	93	This function block makes on-the-fly servo axis changes for speed, accelerations, and decelerations.	MCD	The Motion Change Dynamics (MCD) instruction is used to change speed, acceleration rate or deceleration rate of the move/jog profile in process.

GML Function Block	Page	Description	RSLogix 5000 Motion Instruction	Description
 Redefine Position	94	This function block sets the actual or command position of the selected axis to the commanded absolute position.	MRP	The Motion Redefine Position (MRP) instruction is used to change the command or actual position of an axis.
 On Axis	95	The On Axis, Show Axis Status, and If Axis Fault function blocks program the drive to proceed/not proceed if an axis is faulted.	AXIS_SERVO_DRIVE	The AXIS_SERVO_DRIVE tag structure contains axis attributes that can be used for program direction.
 Show Axis Status				
 If Axis Fault				
 Control Settings	96	The Control Settings, Motion Settings, and Show Axis Position function blocks let you program the drive to change or adjust power-up or working control values such as maximum axis speed, acceleration. They are also used to send axis position, or registration data, for example, to the HMI terminal.	SSV/GSV	<p>The Set System Value (SSV) instruction programs the drive to change or adjust power-up or working control values such as maximum axis speed and acceleration.</p> <p>The Get System Values (GSV) instruction is used to access specific axis or program data.</p> <p><b>IMPORTANT</b> Use Set System Value (SSV) instructions sparingly. If many are needed, stagger them in rungs (with state logic) and wait for the AXIS_SERVO_DRIVE configuration update in process to be off before executing another SSV instruction.</p>
 Motion Settings				
 Show Axis Position				

GML Function Block	Page	Description	RSLogix 5000 Motion Instruction	Description
 Input	98	The Input, Show Input Status, and Output function blocks let you program the drive to control program flow with a dedicated, configured, or miscellaneous input. They are also used for turning on a general purpose, SLC, RIO, AxisLink, or Flex I/O discrete output.	---	BIT Control (RSLogix 5000 folder which contains various instructions)
 Show Input Status				
 Output				
 On Expression	100	The Expression and Equation function blocks, and the EQU instructions let you program the drive to configure a mathematical expression or assign a value, for example, to a variable or cam profile points.	---	Compare and Compute/Math folder
 Equation				
 On Timeout	101	The Timeout and Set Timer function blocks are countdown timers, used to pause the GML software program until the time has elapsed by checking the Wait for Timeout block.	---	Time/Counter folder
 Set Timer				
 Change Gain	102	The Change Gain function block in GML software lets you change the axis gains at any point in the program without affecting the power-up values.	---	SSV
 Direct Drive Control	103	The Direct Drive Control function block directly sets the servo output of the selected physical axis to the commanded voltage, current, or percent of maximum. The maximum settings are either 10V or 150 mA.	---	MDO
 Native Code	103	The Native Code function block lets you write base ICODE instructions in GML software.	---	N/A

GML Function Block	Page	Description	RSLogix 5000 Motion Instruction	Description
	104	The Call Module function block in GML software lets you call and execute for an external module that is a subroutine for the existing GML program.	AOI or Program Control folder	The Add On Instruction (AOI) is used to create your own subroutine for instructions. For example, it is possible to create an AOI routine for fault reset, enabling, and homing an axis. This eliminates having to create the ladder code but it can make troubleshooting the program a bit more difficult. The Program Control block can also be used to jump to another routine.
	105	The Build Table function block sets up the cam points based on the master time versus slave time profile. The Build Table block can also be setup as a variable array used in GML software.	MCCP	The MCCP instruction calculates the CAM profile based on master versus slave profile.
		The Configure Cam function block typically sets up the reference for the Time Lock Cam function.		
		The Time Lock Cam function block sets up a non-linear motion profile for a slave axis with respect to a time base and then execute the specific Time Lock Cam in the required program area.		
	107	The Position Lock Cam function block sets up a non-linear motion profile for a slave axis with respect to a physical, encoder only, virtual, or imaginary axis.	MAPC	The MAPC instruction executes master position versus slave position profile.
	111	Use the Interpolate Axes function block to move a group of two or more servo axes: <ul style="list-style-type: none"> <li>to a specified absolute position or by a specified incremental distance.</li> <li>along a specified linear, circular, or helical path.</li> <li>at a specified speed.</li> <li>at a specified rate of acceleration and deceleration.</li> <li>using a selected motion profile.</li> </ul>	MCLM/MCCM	Use the MCLM instruction to start a single or multi-dimensional linear coordinated move for the specified axes within a Cartesian coordinate system. You can define the new position as either absolute or incremental. Use the MCCM instruction to initiate a two or three dimensional circular coordinated move for the specified axes within the Cartesian coordinate system. New position is defined as either an absolute or incremental position. RSLogix 5000 software cannot make helical interpolation moves.
	115	This function block arms an axis to watch for either a specific position to be reached or a registration event to occur.	MAW	The Motion Axis Watch (MAW) instruction is used to arm motion module watch position event checking for the specified axis
			MAR	The Motion Arm, Registration (MAR) instruction is used to arm servo module registration event checking for the specified axis

GML Function Block	Page	Description		RSLogix 5000 Motion Instruction	Description
	121	The On Task and Task Control function blocks are used in GML software for task control. You can have up to ten motion tasks executing at one time and you may, for example, have tasks waiting for an event or other block to execute.	--->	Periodic or Event-based tasks	You can create a Periodic or Event-based task from the RSLogix 5000 software organizer.
					
	122	The End Program and Restart Program function blocks are used in GML software to end or start a program at any point in the program. Restart Program also lets you begin the program after some fault routine or determination of an anomaly in the GML program.	--->	MCR	The Master Control Relay (MCR) instruction is a mandatory hard-wired relay that can be de-energized by any series-connected emergency stop switch. Whenever the MCR is de-energized, its contacts open to de-energize all application I/O devices.
					
	122	The New Module function block is used to create a subroutine of motion instructions that are used for program maintenance or for external use in the Call Module function at some point in the program.	--->	Periodic or Event-based Tasks	There is one continuous task that has the lowest program priority. You can create a maximum of 32 periodic or event tasks to schedule programs with 15 different priority levels.
	123	The Output CAM function block is used to enable or disable the output cam function. Up to 48 output cam profiles can be configured for Flex I/O, RIO discrete, SLC, or general purpose outputs. These output cam profiles turn on or off at specific axis positions.	--->	MAOC	The Motion Arm Output Cam objects in the MAOC instruction handle the Motion Planner Object Cam functionality. Each Output Cam object is responsible for one output which consists of 32 output bits. Each single output bit can be programmed separately with an Output Cam profile and compensated for position offset and time delay.
	124	The Analog Offset function block lets the motion controller use an analog input to generate a scaled position offset and add that offset to the command position of the selected servo axis.	--->	No instruction in AXIS_SERVO_DRIVE for the Kinetix 7000 drive.	The Kinetix 7000 drive provides an analog input to adjust the position loop, but RSLogix 5000 (version 16 or later) software is required.
	141	The Disable Gearing function block is used to immediately stop the electronic gearing motion of the selected axis with no deceleration.	--->	MAS	The Motion Axis Stop (MAS) instruction is used to initiate a controlled stop of any motion process on the designated axis.

## Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Kinetix 6000 Multi-axis Servo Drives User Manual, publication <a href="#">2094-UM001</a>	Information for mounting, wiring, setup with RSLogix 5000 software, applying power, and troubleshooting information with appendices to support firmware upgrades and common bus applications.
1394 SERCOS interface Multi-axis Motion Control System Installation Manual, publication <a href="#">1394-IN002</a>	Information for mounting and wiring the 1394 SERCOS servo drive.
1394 SERCOS interface Multi-axis Motion Control System Integration Manual, publication <a href="#">1394-IN024</a>	Information for configuring, troubleshooting, and setup with RSLogix 5000 software for the 1394 SERCOS servo drive
1394 Digital AC Multi-axis Motion Control System User Manual, publication <a href="#">1394-5.0</a>	Information for mounting, wiring, setup, applying power, and troubleshooting the 1394 GMC, GMC Turbo, and Analog drive systems.
1394 Digital AC Multi-axis Motion Control System Document Update, publication <a href="#">1394-DU005</a>	New or updated information to use in conjunction with the 1394 user manual, publication 1394-5.0.
Kinetix Motion Control Selection Guide, publication <a href="#">GMC-SG001</a>	A description and specifications for the 2094 family including motors and motor accessories.
Motion Analyzer CD, publication PST-SG003	Drive and motor sizing with application analysis software.
Fiber-optic Cable Installation and Handling Instructions, publication <a href="#">2090-IN010</a>	Information for proper handling, installing, testing, and troubleshooting fiber-optic cables.
System Design for Control of Electrical Noise Reference Manual, publication <a href="#">GMC-RM001</a>	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
Motion Modules in Logix5000 Control Systems User Manual, publication <a href="#">LOGIX-UM002</a>	Information for configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules.
SoftLogix Motion Card Setup and Configuration Manual, publication <a href="#">1784-UM003</a>	Information for configuring and troubleshooting your SoftLogix PCI card.
ControlLogix Controllers User Manual, publication <a href="#">1756-UM001</a>	Information for installing, configuring, programming, and operating a ControlLogix system.
ControlLogix Motion Module Programming Manual, publication <a href="#">1756-RM086</a>	More detailed information on the use of ControlLogix motion features and application examples.
Logix5000 Controllers Motion Instructions Reference Manual, publication <a href="#">1756-RM007</a>	The instructions needed to program a motion application using RSLogix 5000 software.
GML Commander Reference Manual, publication <a href="#">GMLC-5.2</a>	The instructions needed to program a motion application using GML Commander software.
Rockwell Automation Configuration and Selection Tools, website <a href="http://ab.com/e-tools">http://ab.com/e-tools</a>	Online product selection and system configuration tools, including AutoCAD (DXF) drawings.
Rockwell Automation Product Certification website, <a href="http://www.ab.com">http://www.ab.com</a>	For declarations of conformity (DoC) currently available from Rockwell Automation.
National Electrical Code, published by the National Fire Protection Association of Boston, MA	An article on wire sizes and types for grounding electrical equipment.
Allen-Bradley Industrial Automation Glossary, publication <a href="#">AG-7.1</a>	A glossary of industrial automation terms and abbreviations.

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